POWER

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Boss or Bossed?

A MAN who owes much of his success as an executive to his keen observation of men and his intelligent use of them, remarked in a recent conversation:

"Everybody likes to boss or to be bossed."

Satisfaction at having one's own way is so general and obvious that there would at first thought seem to be no obverse to this medal— that everybody would like to be boss.

This may be based upon ignoble gratification at seeing underlings jump to do one's bidding, to justifiable satisfaction at having an unobstructed opportunity to carry out one's ideas and to command the necessary co-operation, or to anything between.

And usually, the smaller the man the more he stresses and makes ridiculous the authoritative and autocratic features of the commanding position.

But there *is* an obverse. People *do* like to be bossed.

When it comes to a crisis, the majority prefer to be told what to do and how to do it.

They fall in behind the man with the loudest voice or the most backing and do the lock step or goose step or mount the treadmill to the nodding approval of constituted or assumed authority.

When it comes to making a decision, to meeting an emergency, to getting the plant out of a tangle, to bringing about needed reforms or realizing demonstrable possibilities, to assuming or inviting responsibility, the natural love of leadership is sicklied o'er with a pale cast of shrinking timidity and the majority bend their necks to him who has qualified to boss them and is not hesitant about doing so.

Most men like to be bossed.

F. R. Low

Midwest Power Conference

HELD in Chicago at the Coliseum from Feb. 15 to ity and diversity of material presented, main attendance was not so great, the total registrati largest gathering at any one session being some 300 ference. This latest co-operative effort of Chicago the front that this is the age of power and its

PROBABLY at no other gathering of like character has the use of power and heat in our great manufacturing establishments been given such diversity of treatment. In six different papers the power and steam requirements of as many industries were given attention and the relations of the one to the other established. Other papers dwelt upon the tremendous electrical development of recent years, the advance in coal-burning equipment and the economies to be anticipated by co-ordinating the gas and electric power supply. In all, thirteen papers were delivered in five sessions. Discussion was not prolific, owing largely to the fact that the material presented had not been preprinted.

Two afternoons were devoted to visualizing some of the things talked about at the conference. Four plants were visited, including Calumet Station of the Commonwealth Edison Company, the main works of the Crane Company, the Illinois Steel Company and the new plant of the Chicago Byproducts Coke Company.

A brilliant feature of the conference was the banquet and dance held at the Palmer House, with an attendance of about twelve hundred.

Samuel Insull had an interested audience in his after-dinner address, in which he passed in review the salient things that have made the last fifty years an electric era. Illuminating his remarks by anecdotes of early

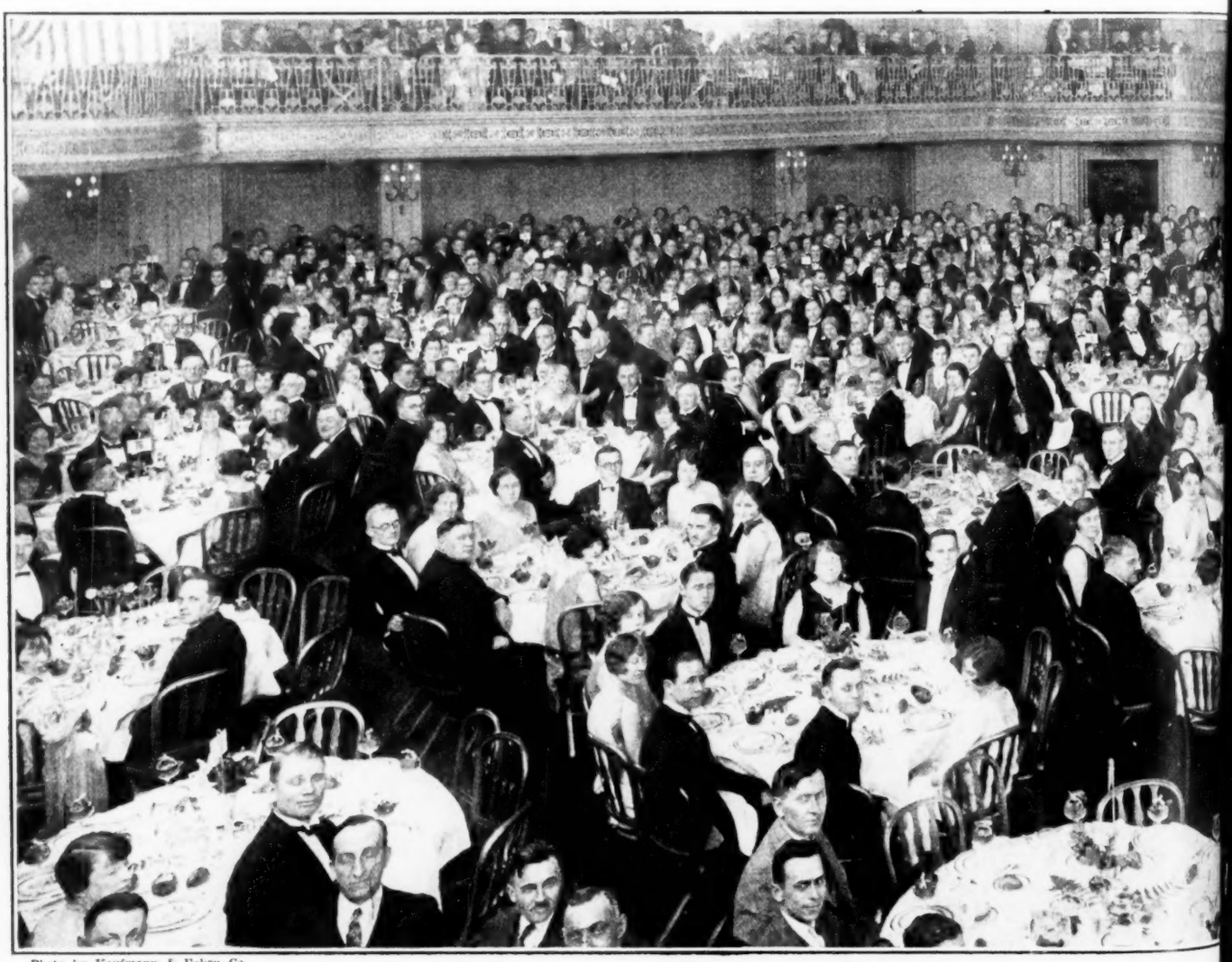


Photo by Kaufmann & Fabry Co.

Midwest Power Conference banquet at

Features Industrial Power

18, the second Midwest Power Conference, in qualtained the high standards set a year ago. The approaching 800, as compared to 1,200, and the short of the 700 maximum attained at the first conengineers is to be commended, for it brought to application to industry is a measure of productivity.

experiences with the various devices and glimpses of the revolution in industry and in home and farm life that may grow out of the present power developments, Mr. Insull pictured America's power-driven machine-made empire of the future.

At the same time he issued a warning to legislative factors that might tend to interfere with the billions invested in the central-station industry, in its effect on the entire country. In connection with the general industrial and commercial development of the country the power business is important. Large amounts of capital are required for its prosecution and that capital has to be invested years ahead of the demand for the product. In his opinion no greater blow could be aimed at the general development of industry than anything that would attack the credit of the great power companies.

Development of Power Supply in Chicago District Outlined by Chairman Monroe

Following an official welcome to the city by Mayor William E. Dever at the opening session on Tuesday afternoon, the purposes that had brought the convention together and the underlying reasons for holding it in the second largest metropolis in the country were expounded at some length by W. S. Monroe, chairman of the Conference. Statistics were cited to show why

the Palmer House with 1,200 at tables

the "capital" of the Middle West had become the center of the industrial life of the nation.

As electrical and mechanical power has been responsible to a large extent for this industrial growth, the outstanding developments of the last year in the power supply of the Chicago district were enumerated. In 1926 the generating capacity was 1,173,065 kw.; the maximum load, 1,040,100 kw., and the output for the year, 4,126,300,000 kw.-hr. The annual consumption per capita is 1,040 kw.-hr. Passing reference was made to the new State Line Station and its 208,000-kw. unit, to the progress in coal burning represented by the powdered-coal installations at the Calumet Station, the developments in the 132,000-volt ring around the city and the interconnections with other systems that will lead into Ohio, West Virginia, Pennsylvania and down through Tennessee and Alabama to Mobile.

Growth of the Power Industry

To show the increasing value of power to home and industry, W. W. Freeman, president of the Union Gas & Electric Co., presented some interesting statistics for which he gave credit in part, to the Society of Electrical Development. Figured at the first of the year, the total capital invested in all branches of the electrical industry was $19,500,000,000 and in the central-station branch alone, $8,400,000,000. The construction budget of the central stations for the year 1927 totaled $958,000,000.

Picturing the growth of the industry over the ten-year period from 1916 to 1926, the kilowatt-hour sales had increased from 21,230,000,000 to 68,732,000,000; the industrial power consumers from 201,000 to 632,000; commercial lighting customers from 810,000 to 2,735,000; the number of wired homes in the country from 4,700,000 to 15,000,000 and the number of persons served from 20,000,000 to 63,000,000. Estimates had been made that not more than 44 per cent of the potential industrial load of central stations had been realized, and in industrial heating it was thought that the present load of 1,000,000 kw. might be increased on a par with the 13,000,000 hp. of motors now existing.

Use of Power in the Steel Mills

Industrial use of power and heat was the general topic of the six papers at the Wednesday sessions of the Conference. F. W. Martin presided at the morning meeting, at which Wilfred Sykes, of the Inland Steel Co., traced power developments in the steel industry, which employs approximately 470,000 persons and pays annually in salaries and wages close to $900,000,000. With each improvement in the development and distribution of power, and the facility with which power can be applied to mechanical devices, there had been an increase in the production accompanied by a reduction in cost and selling prices of the product. Figures from one plant had indicated an increase in production per man of about 35 per cent within the last ten years, notwithstanding the elimination of the twelve-hour day.

In 1926 the amount of power used in the industry was equivalent to about 7,000,000,000 kw.-hr. Of a total of 3,500,000 hp. in motors over 1,000,000 hp. were driven by purchased current.

In plants with blast furnaces the author believes that future practice will be to install efficient steam-driven blowers and turbo-generators and modern boiler plants developed to burn economically surplus blast-furnace gas, supplemented by pulverized-fuel byproducts such as coke braize or by pulverized coal, where the gas supply does not meet the power demands. Interconnection with central-station plants and interchange of energy at times of gas shortage or excess to meet the power requirements will be found an economic advantage to both parties. (A more complete abstract of Mr. Sykes' paper appeared in last week's issue of *Power*.

Discussion of this paper turned to the development of high-pressure turbine plants, resulting in improved economy and lower initial costs; the reduction in man power and the increase in quantity and quality of the product in the last three years from electrification of the mills, and the advantages to be obtained from interconnection with the central station. The steel company has surplus gas that could be used by a gas company, or from it current could be generated and supplied to a central station. The rates that could be paid for this surplus gas or current depend upon the time it is available, the reliability of the supply and the efficiency of the most economical units of the utility companies.

Saving Coal in the Food Industry

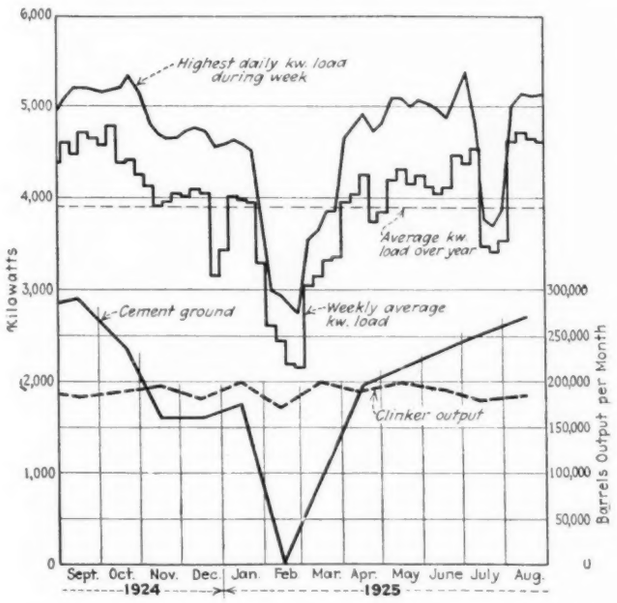
In the food industry the plants of the Corn Products Refining Co. offer an excellent example of power and process requirements for steam. Dating from 1907, when the management of the factories was transferred from chemists to engineers, owing to the fact that 90 per cent of all the work involved in the manufacture of the products called for engineering rather than chemical know'edge, remarkable savings have been effected. In a comprehensive paper, J. J. Merrill, chief engineer of the company, reviewed some of the problems encountered in reducing the coal consumption from 20.3 tons in 1907 to 12.4 tons in 1925, per 1,000 bushels of corn ground, notwithstanding the fact that can-making plants, refined oil plants, cerelose sugar plants and equipment for many other products were in operation at the later date, requiring additional steam and power.

During these 20 years savings in operation and in labor through improved equipment, perfection of factory heat balance and more economical methods of drying were enormous, and based on 1913 labor and material costs, a reduction in maintenance, amounting to $585,000 per year, was effected. (A fuller abstract of this paper will appear in an early issue.).

Use of Power in Paper Mills

Another industry requiring large amounts of power and steam for process is the paper mills. Discussion of the requirements in this industry was made by V. D. Simons, a consulting engineer, of Chicago, specializing in this field. Types of mill for paper and pulp making and the products produced are so varied that the author, considering broad generalizations unsafe, first identified the mill and the products and in each showed the relation between the heat and energy requirements. For example, newsprint and other papers made principally of mechanical pulp or "ground wood" require energy out of proportion to heat, as 1,700 kw.-hr. per ton and only 10,000 lb. of steam. Book paper and paper board mills can be operated on 550 kw.-hr. and 12,500 lb. of steam per ton of product, at a water rate of 22¾ lb. per kw.-hr. Book paper mills in conjunction with soda pulp mills require about 635 kw.-hr. and 15,400 lb. of steam at a water rate of 24¼ lb. Other kinds of chemical pulp mills have little or no use for exhaust steam, so that the energy, when not supplied hydro-electrically, is usually generated by condensing or extraction-type steam prime

movers, as is that of paper mills making white paper out of clean pulp. Other examples were cited and in all definite operating conditions given. Uses for water and the quantities involved, drying of the paper, heat recovery, applications of energy and the boiler room



Weekly load and output curves for cement plant, over twelve months operation

were subjects given attention. Summarizing his conception of the special steam and electrical problems involved, the author said, in effect:

Reduce the energy requirement of the process, if by so doing the cost of fuel and boiler-plant operation can be diminished. If not, reduce the heat requirement of manufacture, and if that be impossible, find a use for the energy available from the necessary steam and apply it to the reduction of labor costs in the mill. Or, balance the requirements of steam and energy by devising ways and means of using any unavoidable surplus of one or the other to attain increased production of paper.

Cement Mill as a Load and Power Producer

Of the various industrial power studies at the afternoon session, of which C. F. Hirshfeld was chairman, that of J. H. Lendi, chief electrical engineer of the Universal Portland Cement Co., on the cement mill as a load and power producer, was of decided interest. Considered as a load the cement mill is unique among industrial plants in that it operates at an exceptionally high load factor over a 24-hour day, any departure from 100 per cent daily load factor being caused by incidental operating difficulties and not by essential interruptions in the process. This condition persists over weeks and months except as influenced by holidays.

Not only is the rate of energy used uniform, but also the consumption of energy is large, as may be realized when it is considered that during the year 1926 the cement industry of the United States consumed more than 1,500,000,000 kw.-hr. An outstanding feature is the fact that the cement mill rejects sufficient heat in the waste gases from the manufacturing process to furnish its own power.

Owing to efficient operation and the nature of the raw materials, the mills of the Universal Portland Cement Co. produce one barrel of clinker for every 900,000 B.t.u. of powdered coal burned in the kiln and from the 65 per cent of this heat rejected recover sufficient energy to operate the mill to which waste-heat boilers are applied.

As might be expected, the application of the waste-heat boiler to the cement kiln met with a number of difficulties never before encountered by a boiler, owing to the presence of a considerable amount of dust of an abrasive nature. Among the lessons learned from pioneer installations are the following:

To prevent tube cutting, a gas velocity of not more than 30 ft. per sec. should be used.

A uniform gas passage with no abrupt turns and little or no horizontal shelving is desirable.

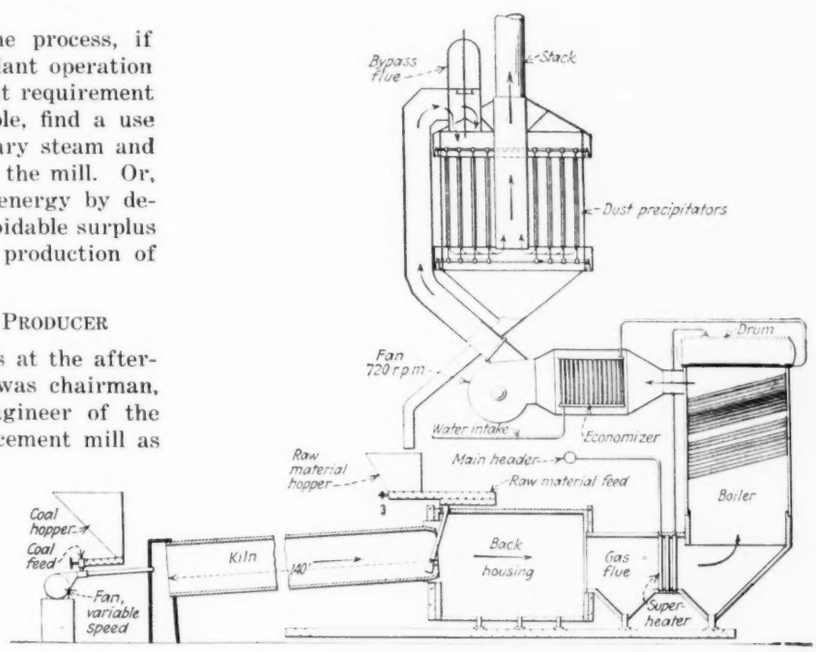
Liberal tube spacing to prevent dust bridges from forming and causing high local velocities.

Accessibility to all parts to facilitate easy cleaning by means of air or steam lancing.

A steel casing that, by stopping air leakage, will prevent secondary combustion and explosions.

Ample means for draining dust lodging in the boiler.

By this company it has been the practice to use individual water-tube boilers per kiln in preference to a common gas chamber connecting several kilns to one or more boilers, owing to the advantages obtained from the definite and individual draft control. The dust in the gases not arrested by the boiler is collected by a Cottrell precipitator.



Typical waste-heat boiler installation with path of gases indicated by arrows

Verification of the fact that no cutting takes place at velocities up to 60 ft. per sec. when the gas flow is parallel to the tubes led to preliminary experiments with a vertical fire-tube boiler. No data are yet available.

Conclusions reached after reviewing nine years of operating data were as follows: The dry-process

rotary cement kiln of dimensions as commonly installed in the newer mills may be operated at a point not far from its ultimate fuel efficiency, and, owing to the inherent inefficiency of the process, rejects sufficient heat to make the installation of a boiler to recover this energy a necessary part of the cement kiln, provided energy cannot be purchased for considerably less than 0.75c. per kw.-hr. and sufficient for the power requirement of the whole mill. The desirability of being connected

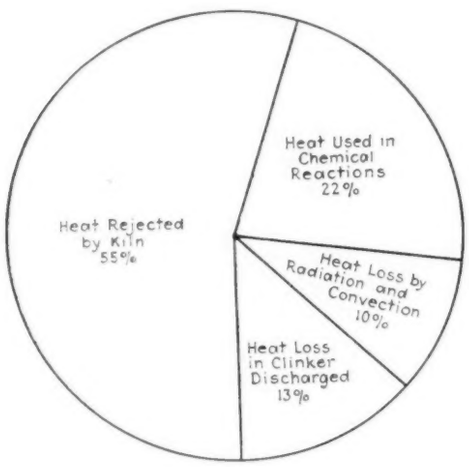

Heat Used in Chemical Reactions 22%
Heat Rejected by Kiln 55%
Heat Loss by Radiation and Convection 10%
Heat Loss in Clinker Discharged 13%

Diagram of heat balance of a typical cement kiln

with another power system to take the excesses of power generated and as a source when momentary shortages occur is, of course, obvious, as is the turbine regulation which is governed by the steam supply and not by the load.

Discussion touched upon the application of synchronous motors to cement mills, including the clutch type, motors giving high starting torque and, where power was limited, the combination synchronous-induction motor. Simplicity, ruggedness and low cost favored the induction motor for sizes of 50 hp. and down. Experiences with waste-heat boilers in 48 different plants confirmed the author's statement that sufficient steam could be generated from the kiln gases to supply the power for the entire mill.

Industrial Power Plant Development

Samuel G. Neiler, of the consulting engineering firm of Neiler, Rich & Co., Chicago, presented a broad story of the general principles of engineering as applied to the development of industrial plants. Special attention was given to the utilization of byproducts such as sawdust from wood-working machinery and waste gases from furnaces and cement mill kilns and the improvement in economies to be anticipated by the extraction of steam from turbines for heating and process and the use of exhaust steam in low-pressure or mixed-pressure turbines. Individual installations were cited with an analysis showing the necessity of a proper correlation of the many items to be considered. Some interesting data were made available on waste-heat boiler installations serving cement kilns, advanced practice in separation of dust from the gases, the handling and burning of wood refuse and improvements made in high-pressure hydraulic work for machinery such as is used in steel-car manufacturing plants.

Specific attention was directed by the author to the items of depreciation and obsolescence which may readily be deciding factors when comparing the cost of operation in the isolated plant with the service company's rates. To determine upon a suitable rate for these two items was a subject worthy of investigation by one of the national engineering societies, and it was the author's hope that this work would be undertaken.

Power and Heat Problems of the Meat-Packing Industry

Production and use of power in the meat-packing industry was covered by C. H. Kane, of Swift & Co. In this industry great quantities of cold and hot water are required, and the heating of this water as well as the heating of buildings and a large part of the processing are done by low-pressure steam, so that the exhaust from many of the auxiliaries and some of the prime movers can be used to advantage where the demand for the exhaust steam can be balanced properly with the supply.

To bring the entire requirements of the packing plant steam processing within the scope of the exhaust-steam system, considerable thought had been given to raising steam pressures for the operation of the power-driven units and exhausting at pressures up to 150 lb. Such a system was confronted with the difficulties of bringing the requirements of processing and heating which occur about eight hours a day in balance with the refrigerating machines, pumps and a portion of the manufacturing load that are required over the 24-hour day. Also the overhead and fixed investment are increased, but where the packing plant is so located that it must look forward to the economical production of its own steam and power, such a plan has encouraging possibilities.

Comparing this method of operating with the plan of generating lower-pressure steam for processing, and the purchase of central-station service for the power requirements, where modern service and schedules are available, Swift & Co. had found the balance in favor of using central-station service. A more detailed abstract of this paper will appear later.

Co-Ordinating Gas and Electric Power Supply

At the Thursday morning session, with W. L. Abbott presiding, an interesting analyses of the economies to be effected by co-ordinating the gas and electric power supply in a typical community of one-half million people was made by Samuel Insull, Jr., president of the Midland Utilities Co. His remarks were limited to financing and operation, the latter meaning the conduct of the business from the moment the plant is completed. In the engineering field of construction and design no savings had been realized, for no commercial installation of the kind was as yet available. Mr. Insull did not enter into a discussion of processes aside from basing his calculations on the hypothesis of a low-temperature distillation plant whose char, retaining its sensible heat, would serve as fuel for steam boilers.

In brief summary the savings of combining the two plants rather than operating them separately, were estimated as follows: Financial, $101,786; operating other than production, $409,080; saving in operation including depreciation, taxes and reduction in charge due to lessening of investment, $283,395. Of the total saving of $794,261 the financier and operator have accomplished two-thirds of the job, and it still remains for the engineer to put into effect an additional one-third of the total saving available.

Other advantages of a combined gas and electric plant were: Elimination of the gas company's problem of disposing of additional coke; a wider fuel market for gas making and the possibility of much greater co-operation between public utilities and other producers of byproduct energy in the form of electricity and coke-oven gas.

Recent Electrical Development

The important part that comparatively recent developments in the generation, distribution and enlarged use of electricity have had in laying the basic conditions for sound prosperity and the great advance in economic conditions in the United States, was the theme of a paper presented by Paul S. Clapp, managing director of the National Electric Light Association. Indicative of this development, the power applied electrically increased from 55 per cent of the total in 1919 to 65 per cent at the present time. In the last thirty years the quantity of power directed by the wage earners of the Country increased 230 per cent, whereas in the same time the number of workers increased 86 per cent. The amount of power per worker rose from 2 to 4 hp. These figures made it evident that a large measure of the increased productivity furnishing the basis of the high wage levels was brought about by the use of more power and more effective application of it to turn the wheels of industry. In proportion as the individual worker had been supplied with additional horsepower, he made strides forward in increasing his capability and in enlarging his usefulness.

Economy in fuel utilization is indicated by the fact that while the electrical output of fuel-burning central stations has increased 67 per cent in five years, the increase in fuel used has been only 15 per cent. A further contribution has been made by the development in the same period of 3,600,000 hp. in water power, representing 36 per cent of the total in use. These savings have been responsible for keeping the price of electricity at prewar levels in spite of the rising costs for labor and material.

Visualizing the enormous increases in the use of electricity, between 1919 and 1926, the consumption of electricity in households increased 133 per cent and the use of power in industry, 98 per cent. The total production of this essential commodity in this seven-year span grew from 34.9 billion kilowatt-hours to 68.1 billion kilowatt-hours, or nearly double. This output of electricity equals the entire output of the rest of the World. It represents five times the output of Germany, seven times that of France, six times the output of Canada, nine times that of Italy and ten times that of England.

Fixing Plant Site and Selecting the Coal

At the Friday morning session, with H. V. Coes presiding, S. A. Taylor, consulting engineer, of Pittsburgh, and president of the A.I.M.M.E., related problems within his experience first on the location of a power plant and second on securing the fuel and water necessary for operation. In locating a plant, he said, distribution of the current to the consumers is the first consideration, and then a suitable water supply and selection of the most desirable coal that can be obtained at the lowest freight rate. Instances are common where it would pay to extend the power lines to a site having abundant water and coal. An abstract of this paper appeared in last week's *Power*.

This was the title of a comprehensive paper by F. S. Collings, mechanical engineer, Sargent & Lundy, Chicago. Although there were indications that the seven-year forced-draft chain-grate era in the Middle West was approaching its decline, the author commented on the rapid development of this class of apparatus to meet the increasing demand for high evaporative rates, flexibility and control of combustion. The most notable improvement has been the application of forced draft to the fuel bed by means of isolated compartments enabling the operator to control the ignition, the burning off of the volatile gases and the final reduction to incombustible refuse, to the best advantage. The application has increased the coal-burning rate to such an extent that stoker capacity has yielded its place as the limiting factor of furnace capacity to the inability of furnace refractories to withstand the high temperatures established, not so much as a result of forced combustion, but as a consequence of the necessity of reducing the excess air to the minimum to secure efficiency and at the same time avoid high draft losses. Complications are the aggravation of the slag problem and the warping and friction in the moving parts caused by the application of preheated air.

Although the underfeed stoker is comparatively little used in the Middle West, owing to the prevalence of free-burning coals and the scarcity of the low-ash coking coal to which the underfeed stoker is so well adapted, attention was called to the improvements that have been made in this type of machine and the remarkable efficiencies and capacities developed.

In the opinion of the author, the most important advances in this decade in the art of steam generation, have been the development of the principle of burning coal in powdered form and the water-cooled furnace. Although the central preparation plant has many advantages and is producing excellent results, it is somewhat too expensive and complicated to justify its use in small plants or even in large ones burning a cheap grade of coal. The situation has resulted in the development of the unit mill, which the author discussed at considerable length, bringing out in particular the elimination of drying before pulverizing the coal, the introduction of secondary air around the burner to produce the short flame and turbulent mixing that permits smaller furnace volumes and the relative economies and difficulties of burning Illinois coal in pulverized form as compared to the use of high-grade Eastern coals.

Reference was made to the recent powdered-coal test installation at Calumet Station, in which an evaporative rate of 300,000 lb. per hour had been reached for a short time. At this rate 30,000 B.t.u. were released per cubic foot of furnace volume per hour, and the indications were that these figures represented by no means the limits of this boiler unit.

Advantages of the unit mill, in the speaker's opinion, include a number of items that may be classed under the general head of flexibility, higher month-to-month efficiency, a furnace adaptable to other fuels and the practicability of using preheated air up to 600 deg. F.

In the discussion decided exception was taken by John Anderson, of Milwaukee, to the author's preference for the unit mill over the bin and feeder system. He claimed that if the same degree of conservatism was used, the latter would not prove too expensive for cheap fuel. Without definite control of fineness and moisture economies in the unit mill would be affected. Large furnaces

were preferred by Mr. Anderson as they permitted large exposure to radiant heat and better separation of ash. It was his opinion that in the near future those engineers who had gone to the use of the more convenient unit systems would find that they had made a mistake. A difference of 6 per cent in efficiency favoring the bin and feeder system was his prediction.

Edwin Lundgren, of the Combustion Engineering Corporation, reviewed the development in driers, passing over the rotary type, the waste-heat and the steam driers as defective and to be supplanted by drying done in a new type of mill. As to the unit system solving difficulties in the powdered-coal field, he said that recent data show that it has all the drawbacks of any system pulverizing coal. Moisture in the coal reduces capacity and fineness is affected by wearing of the paddles. Ash alone is not a criterion of the amount of power required for grinding. It is affected more by the physical characteristics of the coal, moisture and the capacity at which the mill operates. Figures are available showing a consumption of 15 kw.-hr. per ton at maximum capacity and 56 kw.-hr. per ton at one-third load. The storage system has the drawbacks offered by the drier, but with this problem now solved, its use will do away with the frailities inherent in the unit system.

In reply Mr. Collings explained that it was not so much efficiency that he had in mind as dollars and cents, or the ability of one system over the other to make money for the company. Data on costs in his possession gave the advantage to the unit system. More of this paper and the discussion will appear in an early issue.

The Fuel-Oil Situation in the Central States

During the last several years there has been a marked change in the economic position of fuel oil in the United States. In former years nearly all the gas oil and the residual oil obtained as byproducts in the fractional distillation of crude petroleum for gasoline was consumed for fuel. Later the demand for gasoline increased more rapidly than the production of crude oil and it became impossible to obtain enough gasoline by this method; the price of gasoline rose; wide differentials prevailed between fuel oil and gasoline, and the refineries, finding it both feasible and profitable to crack fuel oil for its gasoline content, installed equipment for this purpose to the extent that one-third of the nation's gasoline requirements is now obtained from fuel oil. This profound change in the practice of refining has brought about a lower ultimate yield of marketed fuel oil per barrel of petroleum charged to stills, a new type of fuel known as "cracked fuel oil" and a higher price.

In one of the most interesting papers of the conference, Campbell Osborn, Economist to the President of Marland Oil Company, presented the results of a study for the purpose of measuring these changes, and on the basis of data available, of roughly gaging the future trend of the supply, uses and prices of fuel oil, with particular reference to the central part of the United States. His outstanding conclusions are summarized as follows:

There will probably be no drastic change in the supply of fuel oil for efficient users in the Central States during the next several years. Increased runs to stills are expected to offset decreased yields per barrel of crude. It may be necessary to improve burners so that they will satisfactorily and efficiently burn cracked fuel oil, and to install more Diesel engines. It is uneconomic to burn fuel oil directly in competition with coal on a purely B.t.u. basis, and the use for this purpose will be reduced.

Cracking will further increase, but not as rapidly as in some other parts of the country. It is felt that most of the fuel oil currently produced in the Mid-Continent is being subjected to cracking.

The consumption of oil in Diesel engines will increase despite a rise in price, for the Diesel engine is one of the most economic sources of power from oil.

During the recent past the railroads have met their increased requirements for oil by increasing efficiency. It is doubtful whether the volume they use will again increase except under the stimulus of overproduction. The Diesel-electric-driven locomotive, now in the experimental stage, may some day become a substantial consumer of fuel oil.

The artificial gas plants can now probably compete equally with the gasoline buyers for their requirements.

The use of fuel oil for heating homes and office buildings will increase, because the commodity is largely bought on the basis of convenience, for which the public is willing to pay. This expansion will be slow at first and will depend upon the education of the consumer, further improvements and standardization of burners, and better service after installation.

The use of fuel oil to generate steam for heat and power in inland industries other than railroads is declining.

Automatic Electric Heating Pumping Stations

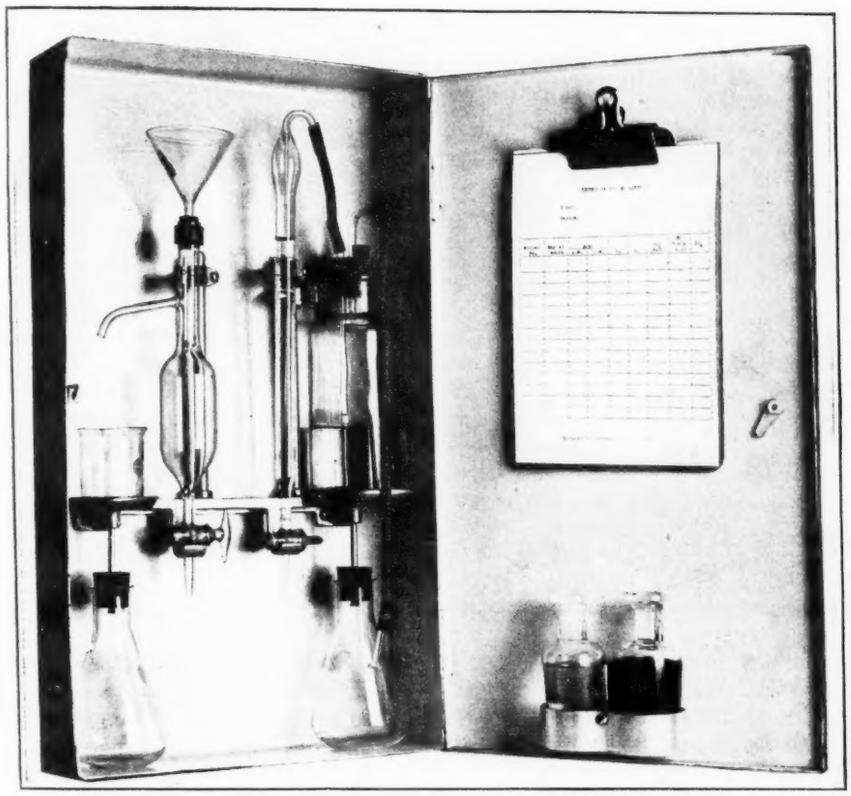
Freezing of the pumps in the automatic pumping station of the town of Morristown, N. J., is prevented by the use of electric heat. The need of close control and the necessity for unattended operation precluded the use of fuel. The pumping station, a brick building about 22x29 ft., is at some distance from the town and is exposed to the elements on all sides. In order to prevent the pumps from freezing in cold weather, a total of 30 kw. of electric heating units was installed, General Electric oven heaters being used. Six of these units are now in operation, connected two in series, three-phase star on 440 volts.

The heaters, protected by a screen, are arranged along the north and east walls, near which the pumps and other equipment are located. The heaters are controlled with a standard automatic panel and temperature control instrument of the type ordinarily used with industrial ovens.

In order to secure the benefit of the minimum rate for power, it is necessary to cut out the heaters for several hours in the early part of the evening. With this in mind, the present installation was designed to maintain a temperature of 50 deg. F. during the day, as it was estimated that, during the period the heaters are cut out, the temperature in the station would fall about 10 deg. The minimum outside temperature was estimated at 10 deg. below zero. It has been found that the cost of heating the building in the coldest weather, so far experienced, averages about $20 a month, including current at 1½c. per kw.-hr. Since the successful operation of the Morristown installation similar equipments have been chosen for other plants.

Overcoming Boiler-Water Troubles with Tri-Sodium Phosphate

By B. C. SPRAGUE*



Apparatus used for testing the boiler water
No chemical knowledge is required for its operation

SULPHATE waters will not cause adherent scale if enough sodium carbonate is added to maintain a certain ratio between the carbonate and the sulphate in the boiler water. At high operating pressures, however, most of the sodium carbonate decomposes into sodium hydroxide, making it difficult to maintain the desired ratio. This difficulty can be avoided by the use of tri-sodium phosphate.

THE general adoption of surface condensers has been a large factor in reducing the troubles occasioned by scale formation in power-plant boilers. In order that the high boiler ratings made possible by recent improvements in furnaces may be secured without loss of availability and expense resulting from boiler-tube failures, many of the larger stations built during the last few years have been equipped with evaporators.

However, even where evaporators are used together with surface condensers, it is not possible to prevent entirely the entrance of scale-forming salts into the feed-water system, because the condenser leakage cannot be reduced to zero. Condenser leakage, in large power plants, is frequently one per cent of the feed water. This is sufficient, if not properly treated, to occasion considerable expense, either in the frequent turbining of the boiler tubes or in the losses resulting from tube failures.

The increasing use of water-cooled surfaces in the sides and bottoms of boiler furnaces, where the rate of heat absorption is many times the average rate for the boiler, has tended to emphasize the importance of proper treatment of the feed water.

Whether the feed water is composed of the main condenser condensate, supplemented by evaporated makeup but containing the condenser leakage, or is raw water that has been treated in a lime-soda system, the problem of preventing the formation of scale in the boilers is the same in kind. In both cases small quantities of the scale-forming salts contained in the raw water will be present in the feed water, and these will precipitate when subjected to concentration and increased temperatures in the boiler.

To Dr. R. E. Hall is due the credit for having shown how the laws of physical chemistry can be so applied to the conditioning of the feed water in boilers as to dispose of the scale-forming components of the feed water by causing them to be precipitated as sludges rather than as scales. Doctor Hall has ably explained, in his numerous papers, why some precipitates adhere to the boiler tubes to form scales while others do not.

Where calcium salts were present in large concentrations, the lime-soda type of softener has been most extensively used. In this softener the calcium bicarbonate is precipitated by conversion to the mono-carbonate

*Efficiency Engineer, West Penn Power Company

(the solubility of which is low) by the raising of the water to the boiling point or by the addition of calcium or sodium hydroxide. The calcium existing in combination as calcium sulphate is precipitated by the addition of sodium carbonate (soda ash). Soluble sodium sulphate is left in solution. The water leaving the softener is passed through a filter to remove the calcium-carbonate precipitate. Water treated in this manner contains all the sulphate originally contained in the raw water, together with all the sodium added at the softener. As the solubility of calcium carbonate, although low, is not zero, the feed water also contains an appreciable concentration of this salt.

Where the lime-soda type of softener is used, it is the practice to add sodium-carbonate in excess of the requirements for precipitating the calcium existing in combination as calcium sulphate. This excess of sodium carbonate tends to reduce the solubility of the calcium carbonate and hence reduces the quantity of calcium entering the boiler. It also tends to prevent the precipitation of this calcium as an adherent scale when it once gets into the boilers.

In the larger plants and those in which some attempt is made to control the chemical conditions in the boilers, the amount of the excess of sodium carbonate that is added is governed by the analyses of the treated feed water in accordance with curves or rule-of-thumb relations which the manufacturers of the filtering systems have developed. Where nearly all of the feed water is condensed, it is generally the practice to add sodium carbonate in proportions governed by similar rough criteria.

This treatment is fairly successful in the great majority of cases where the recommendations of these manufacturers are diligently followed. But with the advent of higher pressures there is an increasing number of cases where this form of treatment fails. This failure is, of course, due to the fact that the chemical conditions in the boilers are not so controlled as to dispose of the small amount of calcium that cannot be removed by the softener or which enters the feed-water system in the condenser leakage.

Preventing Scale by Maintaining Definite Ratio of Carbonate to Sulphate

By applying the laws of physical chemistry to the conditions obtaining in the boiler water, it can be shown that the calcium entering the boiler with the feed water can be caused to precipitate as sludge-forming calcium carbonate rather than as scale-forming calcium sulphate, provided the concentration of carbonate radical in the boiler water is kept above a certain value. This required value of carbonate radical concentration, it can further be shown, is approximately proportional to the concentration of sulphate radical in the boiler water.

One reason why the standards of boiler-water conditioning now commonly used fail, is that they take no account of the sulphate-radical concentration in the boiler water, the value of which depends upon the sulphate radical concentration of the feed water, as well as on the amount of blowdown.

Probably the greatest number of failures are due to the fact that the excess of carbonate added is not sufficient to allow for the conversion of the sodium carbonate to sodium hydrate, which occurs in the boiler. This conversion, which results in the giving off of CO_2 gas with the steam, is much accelerated when the boiler is operated at high pressures. The result is that a much greater excess of sodium carbonate must be added to the feedwater.

With boiler pressures of 300 lb. or more, it is frequently found that the required carbonate concentration cannot be obtained without adding excessive amounts of sodium carbonate and causing the hydroxide concentration in the boiler to reach objectionable values. As pointed out by Doctor Hall, it is in these cases that tri-sodium phosphate finds its application, because upon dissociation, it does not break up into any volatile compounds, such as the CO_2, which can be carried out of the boiler.

How Tri-Sodium Phosphate Solves Difficulty

The action of the phosphate ions, in combining with the calcium ions to form a harmless sludge, is similar to that of the carbonate ions. The minimum concentration of phosphate radical required to prevent the precipitation of the scale-forming calcium sulphate also varies approximately in proportion to the sulphate radical concentration, and is also higher the greater the pressure at which the boiler operates.

Experience has demonstrated that with boiler pressures of 300 lb. gage, it is sufficient to keep the concentration of phosphate radical in excess of 10 per cent of this concentration of sulphate radical.

Since the concentrations of phosphate and sulphate radical, the relative values of which determine whether or not the calcium is precipitated as phosphate or sulphate salt, cannot be predicted from the feed-water analysis, it is necessary that they be determined by analyses of samples of the boiler water. Very simple methods of titration have been developed for the determination of these quantities. The accompanying photograph shows a portable outfit for making these determinations. This is especially well adapted for use by unskilled operators.

Where lime-soda type softeners are used and tri-sodium phosphate is adopted, the treatment should be the same as before, with the exception that instead of adding an excess of sodium carbonate, sufficient tri-sodium phosphate should be added after the water has passed through the softener to give the required concentration of phosphate radical in the boiler water.

When tri-sodium phosphate is used, the boiler water should always be kept alkaline to the phenolphthalein indicator. The hydroxyl concentration of the boiler water can be increased by adding a slight excess of sodium carbonate in addition to the tri-sodium phosphate. This sodium carbonate is usually converted over to sodium hydrate, a small amount of which will greatly increase the hydroxyl concentration. If the hydroxide concentration becomes objectionably high, it will be necessary to reduce the sodium carbonate.

There are other scale-forming salts to be encountered in some cases, the precipitation of which can be inhibited by methods similar to those employed in the case of calcium sulphate.

Tro-sodium-phosphate treatment has been used for nearly three years in one of the larger power stations of this country where sodium carbonate was previously used under the direction of a staff of skilled chemists. With the sodium-carbonate treatment frequent turbining of the boilers was necessary. Boilers which were placed in service in this plant over two years ago and which have been treated with tri-sodium-phosphate, have never yet been turbined and show no signs of scale formation or corrosion.

Commutator Maintenance

Faults That May Develop in the Commutator of a Direct-Current Machine, with Suggestions as to How These Faults May Be Remedied

By C. O. MILLS

BEFORE good operation at the commutator and brushes of a direct-current machine can be expected, the commutator must have a true surface and the brushes must be properly fitted. This may not always cure a persistent case of sparking at the brushes, but it is one of the first essentials in the remedy. The higher the commutator speed the more important the condition of the commutator's surface becomes in sparkless operation.

Location of the Brushes

If the surface of the commutator is not kept trued up, it will become worn in grooves, especially if the brushes in the different holders are not properly staggered so that they wear the whole surface of the commutator. The way the brushes should be staggered is indicated in Fig. 1. Brush *A* is located so that it rides on the surface between brushes *B* and *C*. This also applies to the other brushes; they cover the space not covered by the brushes or the other studs.

One of the easiest methods of truing up a commutator is with a commutator stone, of the types shown in Figs. 2 to 4. The type Fig. 2, is for use on small commutators, and those shown in Figs. 3 and 4 are for medium- and large-sized machines respectively. The size of a stone should be such that it can be worked freely between the brushes; in some cases this may require the removal of some of the brushes. Moving the stone endwise across the face of the commutator helps materially in doing a good job. The grade of stone to use will be determined to some extent by the job to be done, and the manufacturers of the stones are always willing to render assistance in this matter. Where a considerable cut is to be taken off the commutator, it will be best to use first a coarse grade to do the heavy cutting and then finish with a finer grade.

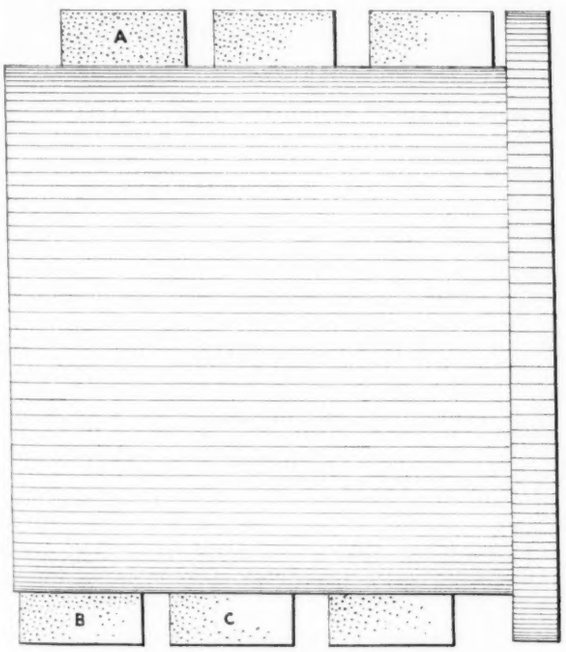
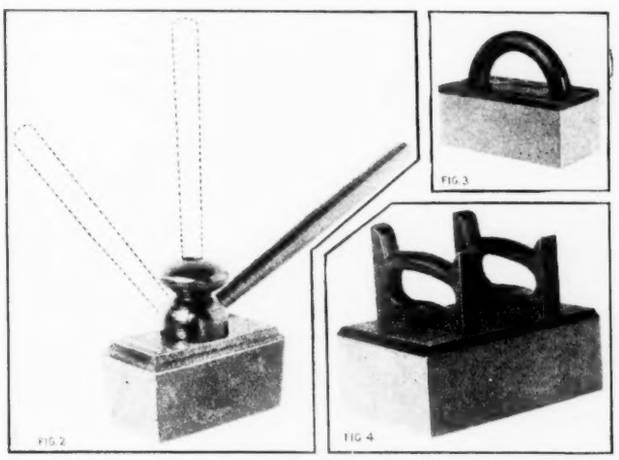


Fig. 1—Shows how brushes should be staggered on the commutator

Before applying such stones, it is well to clean the surface of the commutator with a piece of sandpaper, as this will prevent the surface of the stone glazing and interfering with its cutting qualities. As long as a commutator does not spark, it should need very little grinding. When a good glazed surface has been established, it should be left alone, except for wiping off with a piece of canvas to remove any dirt that may collect. When ridges begin to form, they should be cut down with a stone.



Figs. 2 to 4—Stones used for grinding commutators

Making Commutators True by Grinding

Contrary to what might be expected, turning a commutator in a lathe does not insure a true surface when in operation. This also applies to grinding a commutator when turning in a lathe. It may be true while in the lathe, but when put into the machine and brought up to speed, centrifugal force may distort its surface. The only way of insuring a true surface under these conditions is to grind the commutator when turning at normal speed. In some cases it may be impossible to get the surface as true as desired with a hand stone. In that event a grinding equipment with a revolving wheel may be used, which is mounted on the machine and is provided with a rest that allows adjusting the wheel to the commutator and moving the revolving wheel across the commutator's surface. One type of such equipment is shown in Fig. 5. Such devices generally use grinding wheels varying in diameter from 6 to 10 in. The speed at which the wheels operate will

be determined by the speed of the commutator. The commutator and stone revolve in the same direction, so that the two surfaces that come in contact move in opposite directions, and the peripheral speed of the wheel is added to that of the commutator.

Cutting Speed for Grinding Wheels

It will probably be well to consult the manufacturer of the wheels as to the cutting speed recommended. However, in the absence of this information, 6,000 to 7,000 ft. per min. may be taken as a good average cutting speed. Commutators usually have a peripheral speed of from 2,000 to 4,000 ft. per min. Then if the machine is operated at full speed and the commutator has a peripheral speed of 3,000 ft. per min., the grinding stone should have a peripheral speed of 3,000 to 4,000 ft. per minute.

Whenever possible it is best to operate the commutator at full speed and then drive the wheel at a rate that will give the best cutting speed. In this way the commutator is subjected to about the same forces that it is subjected to in normal operation, and if there is any distortion of its surface it will be corrected in the grinding process.

A grinding wheel mounted on a substantial rest will put a truer surface on a commutator than will any other method. It is, however, best suited to cases where the commutator is in bad shape and considerable material is to be removed, or for use on large commutators, as it requires considerable time to set the equipment up and get ready for doing the grinding. For cleaning up commutators and taking light cuts, hand stones are well suited and are easily applied, and generally without taking the machine out of service. However, after a grinding job is done, it is best to shut the machine down and clean up the brushes and their holders and other parts. Hand stones may, on small and medium-sized commutators, be used to take off a fairly heavy cut. Contrary to what might be expected, the commutator will generally tend to come to a true circle, irrespective of what the condition of its surface may be when the grinding is started.

If attention is given to keeping the commutator in good condition, it should greatly prolong its life. After flat spots or other defects occur on the surface, they

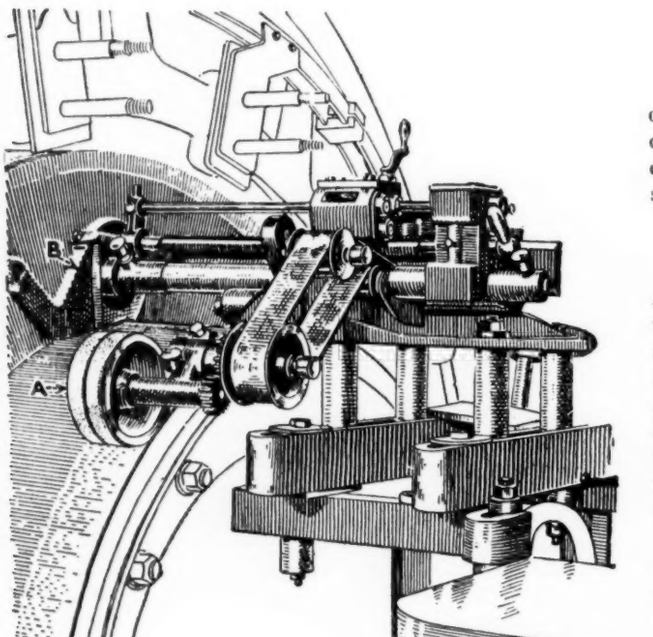


Fig. 5—Grinding wheel mounted on machine for truing the commutator

A—Wheel for driving grinding wheel from commutator. *B*—Guard around grinding wheel connected to exhauster for carrying away the products of the grinding process.

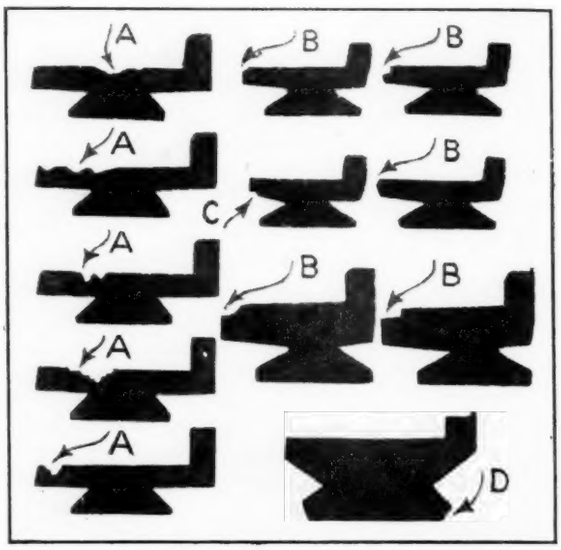


Fig. 6—Examples of where the mica in commutators fails

quickly develop into a fault that will require a heavy cut. This can be largely avoided by truing up the commutator when the trouble first develops, and hand stones are well suited to this class of work.

Short-Circuits in Commutators

Among the faults that may develop in a commutator are short-circuits between bars. These are caused by the mica insulation becoming carbonized, and Fig. 6 shows a number of examples. The letters *A*, *B*, *C* and *D* indicate the most common places for the mica to disintegrate. All these examples have been taken from commutators that were being repaired. Oil is one of the most prolific causes of mica carbonizing in commutators and care should be exercised to keep it off the commutators and windings.

A short-circuit between commutator bars will cause the bars on each side of the defect to heat and may cause them to rise above the rest of the commutator surface. Cases are on record where the bars have come up far enough for the brushes to knock them out of the commutator entirely. Needless to say, the brushes and brush rigging were also damaged.

A short-circuit in a commutator, if on the outer periphery where most of them occur, can generally be repaired by carefully cleaning the defective mica out and filling the void with a commutator insulating compound. If the space is of considerable size, a piece of mica may be fitted and held in place with shellac. After the defect has been repaired, if any of the bars have been raised, they should be filed down level with the surface of the commutator and the commutator trued up with a stone.

Another cause of high bars is loose assembly of the commutator, in which case the commutator should be tightened. This should preferably be done when the commutator is hot, as the insulating compounds are then softer and the bars will pull together easier than when cold. In the case of large commutators care must be exercised not to get them too tight, and the tightening process should be done so as to bring all the bolts up together or there will be danger of distorting the commutator.

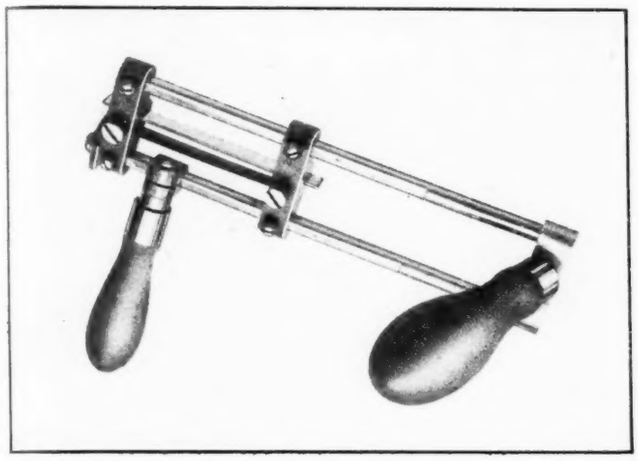


Fig. 7—Saw for undercutting commutator mica

Effects of High Bars

High bars lift the brushes above the normal surfaces of the commutator, and when they move out from under the brushes, contact is broken with the surface of commutator and sparking results. This usually causes burning of the commutator at the high bars, and is one of the causes of flat spots. Brushes too tight in the holders will prevent their following any slight irregularities in the commutator and will cause flat spots. Anything that might cause repeated sparking at one spot on the commutator will cause flat spots. Of course the remedy is to remove the cause, which, if in the commutator, is done by truing up its surface.

High mica is another cause of poor operation of the commutator. Where the copper wears lower than the mica, the brushes are lifted clear of the bars and sparking results between the brushes and the bars, which soon aggravates the conditions by eating the copper still lower. Truing the surface of the commutator with a stone will relieve the trouble, but not, in general, make a cure. Undercutting the mica is generally the only permanent cure for this trouble. Since it has become common practice to undercut the commutator mica, trouble from high mica has been pretty well eliminated.

Methods of undercutting the mica vary widely. In some cases on small commutators the undercutting is done with a piece of hacksaw blade held in a wooden handle or with a riffle file. Fig. 7 shows a saw constructed especially for this class of work. A power driven slotter and how it is used is shown in Fig. 8. After slotting, the burs and rough edges should be removed from the edges of the bars and the commutator's surface made smooth by stoning.

Open-circuits in the armature winding will cause severe sparking at the brushes, particularly if the machine is loaded, but loose or high resistance connections may cause blackening of the bars in the region of the defect. If this fault is not remedied, it will usually lead to serious sparking and a flat spot on the commutator. Where the commutator is eccentric, particularly at high speed, sparking will generally result. This defect is not readily removed by hand stoning and will generally require truing in a lathe or with a grinding wheel as previously explained.

Flat Spots on Commutator

Among the most annoying troubles with commutator operation are flat spots. On some commutators these are particularly persistent in developing. These cases are usually due to some defect in the commutator, the armature winding or in the prime mover.

As previously mentioned, a commutator may be distorted owing to centrifugal force and, although round at slow speeds, may be considerably out of round at high speeds. Changes in temperature may also cause distortion of the commutator surface. Vibration due to unbalance of the machine or prime mover, or on account of poor foundations, has been found to cause flat spots on commutators. This is particularly troublesome if the vibrations are of a periodic nature and cause the brushes to break contact with the commutator at certain spots. Other causes are loose brushes or unstable mounting of the brush-holders, and loose bearings or pounding of a reciprocating engine. Chattering of the brushes may cause flat spots. This fault may at times appear to be quite difficult to remedy, but if the brushes are of the proper grade for the service and are set at the correct angle, there should be little trouble from this cause.

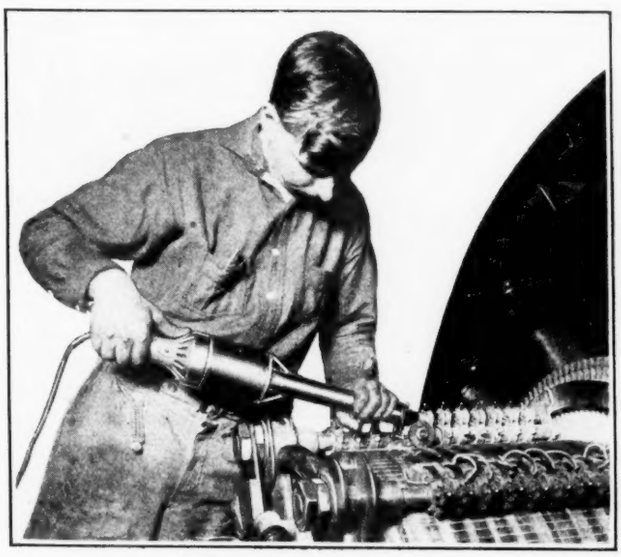
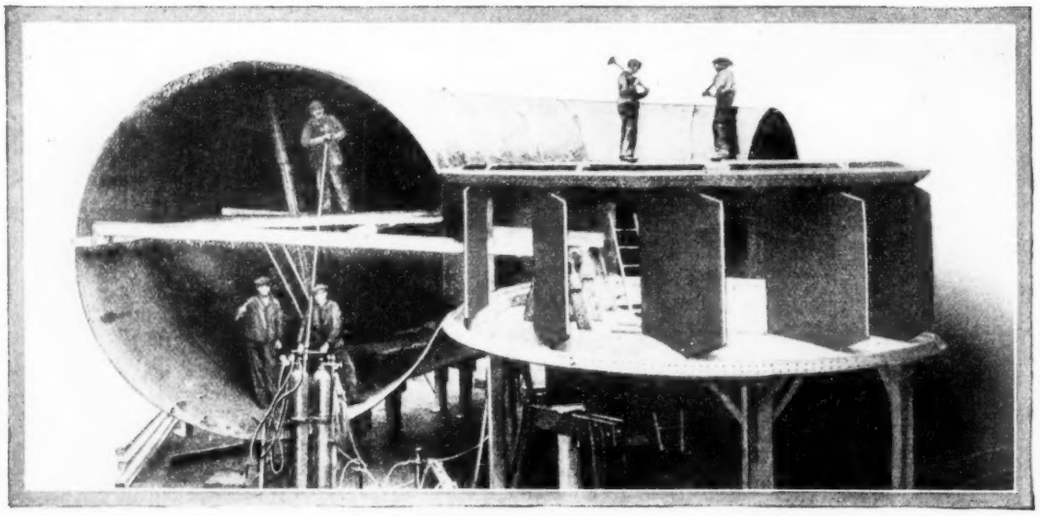


Fig. 8—Power-driven slotter for undercutting commutator mica

It should not be understood that putting the commutator in good condition is a cure for all trouble that may develop on this part of the equipment. There are many other causes of trouble at the commutator, but it is not a good plan to go searching in some other part of the machine until it has been established that the commutator is not at fault.



Steam Cuts Steel

Below—Steam blowing from a superheater handhole cap severed this bridge in 24 hours.

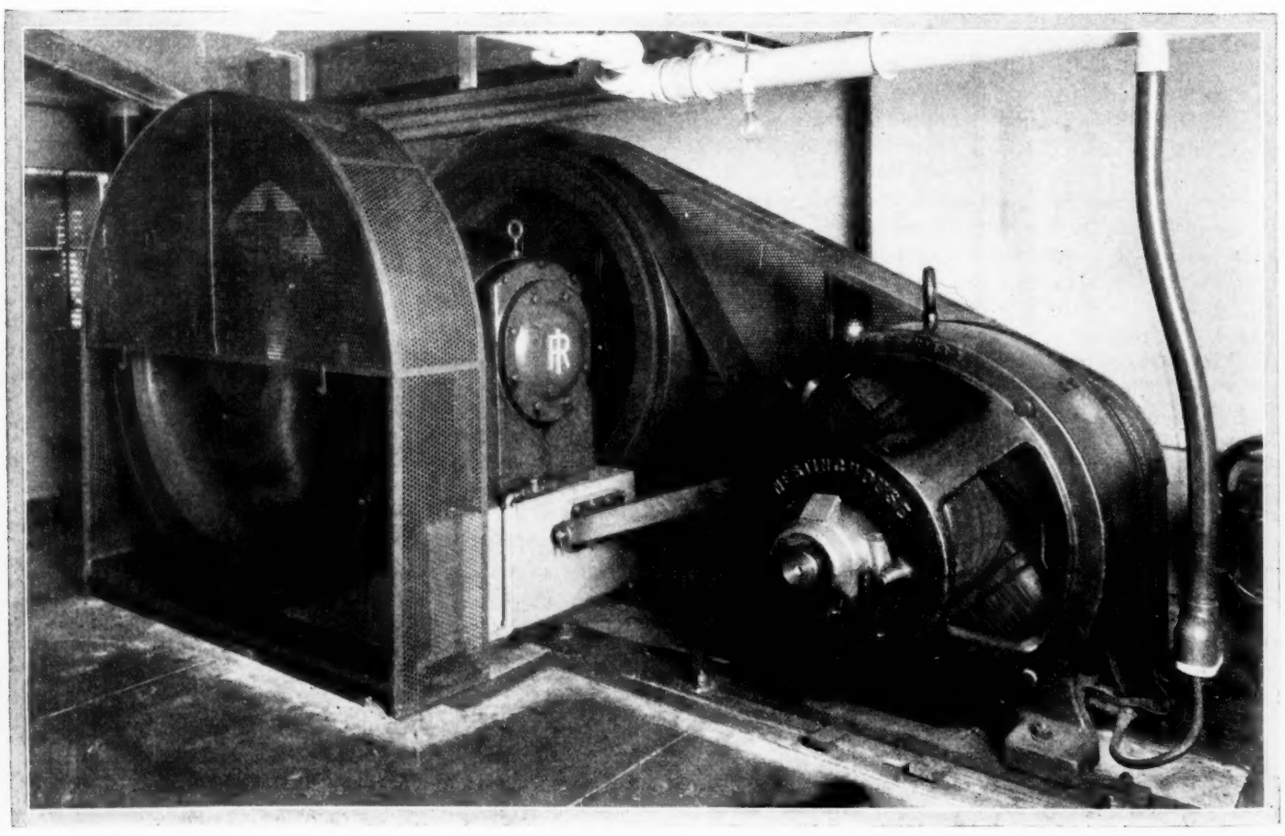
"Where the River Shannon Flows"

Above—Ireland's River Shannon, the inspiration of poets, is now being harnessed by 2,500 German and Irish engineers and workers. The photograph, reproduced from V.D.I. Nachrichten, shows speed ring and part of casing of one of the six 38,500-hp. turbines.

Photo by Courtesy of Detroit Edison Synchroscope

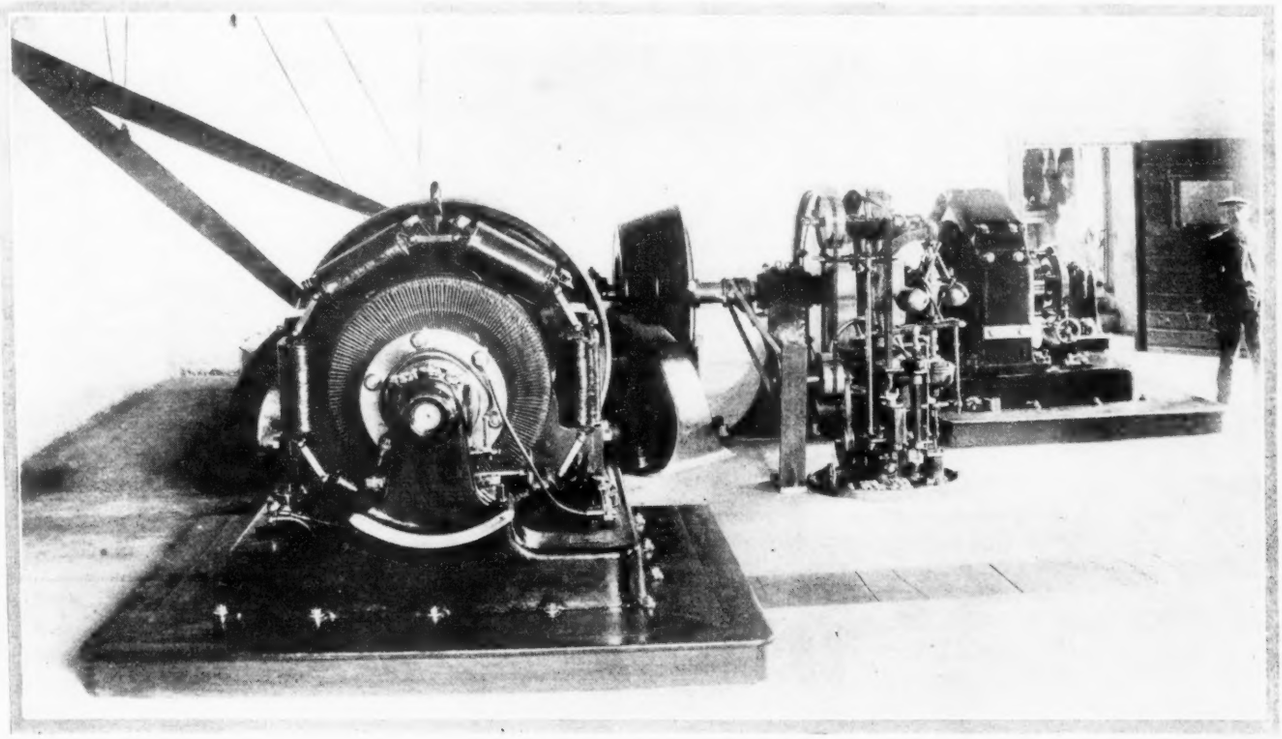
Compact and Safe

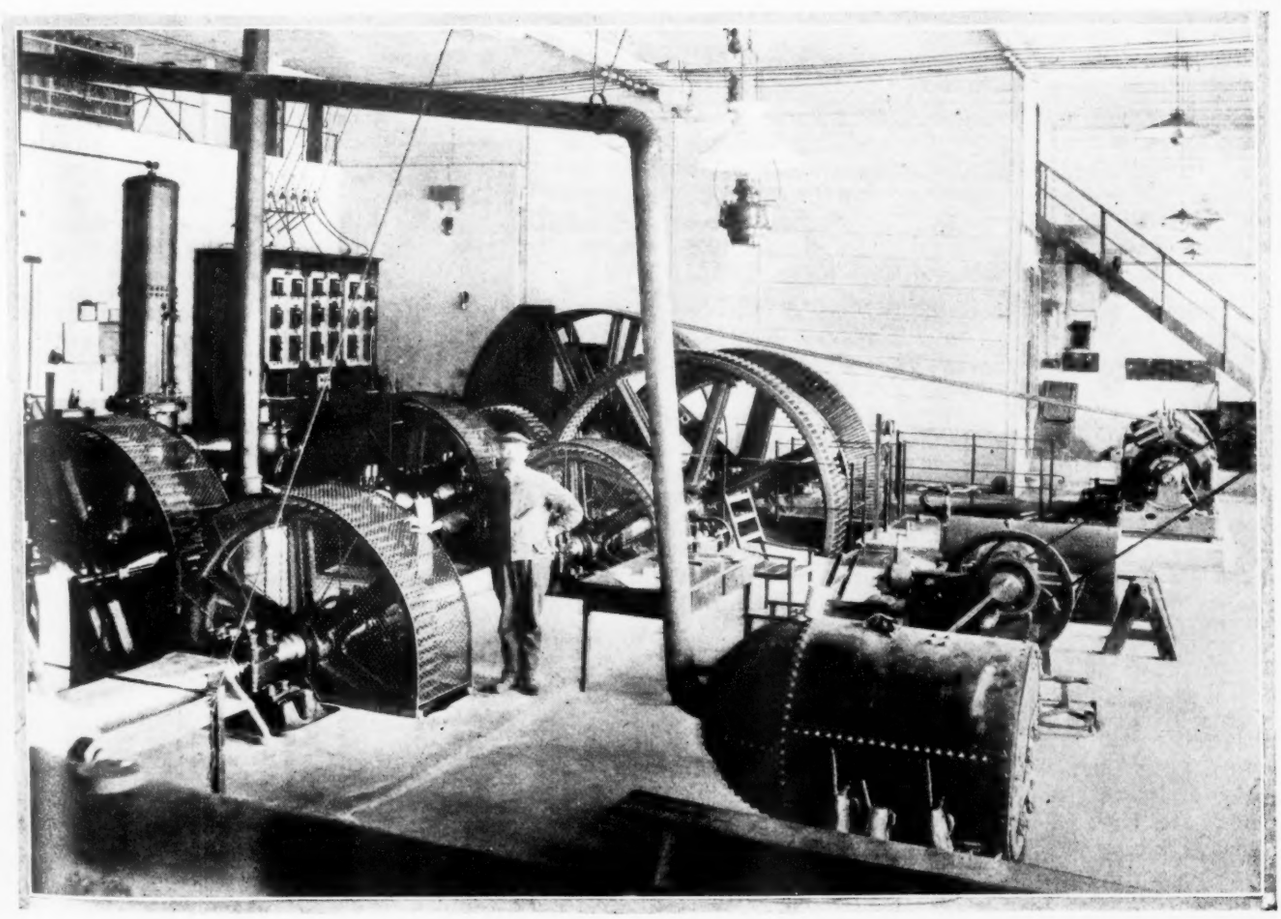
Below—The short-center idler-pulley drive not only saves floor space, but greatly simplifies the problem of safeguarding the installation



A Swiss Remnant of the Good Old Days

Dotting the picturesque mountainous country of Switzerland are innumerable water-power plants, some old and some of the most modern construction. Here are two views in the old plant at Fribourg. It was started in 1872, but most of the equipment shown was installed between 1890 and 1895.





Steam Power From the Ocean in the Tropics

By R. H. ANDREWS

AT THE Nov. 15 meeting of the French Academy of Sciences a novel and slightly startling proposition for the production of power from ocean water in the Tropics was outlined by two well-known scientists, Georges Claude and Paul Boucherot. Press accounts have aroused considerable interest among engineers and Power *has had many inquiries concerning it. Hence this analysis by Mr. Andrews, our Paris correspondent.—Editor.*

THE essence of the proposal is to use the temperature difference in tropical seas between the surface water and the depths, for the generation of energy. The water at a depth of 3,000 ft. or more is said to remain throughout the year at a practically constant temperature of 39 to 40 deg. F., while the surface temperature varies slightly around 80 to 85 deg. *The idea is to use water from a depth of several thousand feet as condensing water, and to evaporate the surface water under the very high vacuum attainable, interposing between the "boiler," or steam generator, and the condenser a low-pressure steam turbine for the production of power.*

A practicable demonstration on a diminutive scale was made before the Academy, using a 6-in. De Laval turbine driving a small generator, and two 6-gal. glass jars, one containing water at a temperature of 82 deg. F., acting as the steam generator, while the other, filled with cracked ice and connected to an air pump, served as the condenser. Though the turbine was designed for a higher steam pressure, it ran at 5,000 r.p.m. for about 8 min., until the water in the steam generator had dropped to 65 deg.

It will be noted that the process of steam generation from warm water, by the use of the sensible heat content of the water, is the reverse of the process of condensation. In the latter the latent heat of vaporization of a small weight of steam is absorbed by a large amount of cold water, causing a temperature rise in the condensing water; in the former process no outside source of heat being available, the latent heat necessary to produce a small weight of steam must be supplied by a large amount of warm water, causing a temperature drop in the latter.

Since the condensate need not be re-evaporated, jet condensers could be used or the problem might be further narrowed down to barometric condensers, as giving the lowest cost. Thus, in the Claude-Boucherot power scheme, steam may be generated and condensed in a species of barometric condenser, the steam generators being in fact inverted condensers, receiving warm water and supplying steam.

Assuming the surface and deep water to remain at constant temperatures of 82 and 40 deg. F. respectively, the greater the amount of surface, or "vaporizing," water used to produce one pound of steam, the nearer to 82 deg. will be the steam temperature at the turbine throttle; also the greater the amount of cold water used to condense one pound of steam, the lower will be the exhaust temperature. Therefore, the greater the water quantities used, the greater the energy available from the steam during expansion.

Estimate Pumping Head

One of the limiting factors would be the pumping cost. Vaporizing water, being pumped from the sea level only and returned thereto by gravity, the injection pumping head may be assumed arbitrarily to fall between 10 and 15 ft. The condensing water, on the contrary, would be drawn from a depth of several thousand feet; let us assume 3,000. The static pumping head would be composed first of the lift from the sea level to the injection nozzles, or about 50 ft.; secondly, of a differential head proportional to the difference in mean density between the water inside and that outside the casing. This would be about four feet, which is almost negligible.

The friction head could probably be kept low with moderate water velocities, on account of the large size of the casing; it will be assumed not to exceed 20 to 25 ft. With these assumptions the effective injection pumping head for the condensing water may be estimated to lie between minimum and maximum values of 30 and 45 ft. respectively, or three times the pumping head for surface water.

As already stated, it would be necessary to sacrifice a fraction of the total available temperature range of 42 deg., partly to vaporize the steam and partly to condense it. Since the pumping head for the surface water is assumed to be about one-third of that for the deep water, it would be logical, in order to divide the pumping cost equally between the steam generators and condensers, and particularly, to reduce the cost of the condensing-water casing, to use about three times as much surface as deep water.

The pressure range being beyond the limits of the existing Mollier diagram, data have been calculated and certain assumptions made. The results have been computed without considering any auxiliary power consumption except for pumping, as this is so large that it probably dwarfs all other auxiliary losses.

Steam and Water Consumption

The maximum values reached by the output curves for maximum and minimum pumping heads are 25 and 31.8 B.t.u. per pound of steam, corresponding to consumption figures of about 335 and 400 lb. of surface

water, and 135 and 115 lb. of deep water, respectively, per pound of steam. These tremendous water quantities would require very large equipment, and the interest on the capital invested would make it advisable to compromise and adopt smaller water quantities.

Therefore, let it be assumed arbitrarily that the most economical water quantities are 250 to 1 for surface, and 84 to 1 for deep water. The corresponding useful generator output lies between a minimum of 23.6 and a maximum of 28.1 B.t.u. per pound of steam. Using the minimum value, an attempt will now be made to form an approximate idea of the dimensions of the steam generating and condensing equipment, as compared to present-day jet condenser installations.

One of the largest jet condensers ever built is that serving a 35,000-kw. turbine unit at the station of the Narragansett Electric Lighting Co., Providence, R. I. This condenser requires about 36,000 gal. per min. of injection water, or about 51 lb. per pound of steam, and 514 lb. of injection water per kilowatt-hour. The condenser in the Claude-Boucherot plant for like turbine capacity, would consume 23.7 times, and the steam generator over 70 times, as much injection water per kilowatt-hour. The volume of steam to be handled by the condenser would amount to nearly 35 times that of the Narragansett condenser.

Size of Steam Ducts

It would seem that, from the viewpoint of steam- and injection-water handling capacity, the size of the steam generating and condensing equipment would not be prohibitive. It is likely that the steam generators would not cost much more per kilowatt capacity than a modern boiler plant. Serious difficulties would likely be met in the steam circuit between the steam generator and the condenser, in the design of the turbine and of the steam lines necessary to connect the latter with the steam generator and the condenser.

The total static pressure drop available between the steam generator and the condenser is only slightly more than one-half inch of mercury. It is therefore evident that every means must be used to avoid losses through fluid friction, bends in the ducts and eddying of the steam, and that steam velocities must therefore be kept low. In view of the very low pressure drop available, let the exhaust velocity be limited to 100 ft. per second.

The volume of exhaust steam would be 225,300 cu.ft. per kw.-hr. or, for a 35,000-kw. unit, the total volume of steam to be handled would be about 2.2 million cubic feet per second. In order to keep the steam velocity down to 100 ft. per sec., the exhaust casing, if of circular section, would have to be *170 ft.* in diameter. If a velocity of 200 ft. were permissible, however improbable this may seem, the diameter of the exhaust casing would still have to be about 120 ft. The supply duct from the steam generator to the throttle would have to be over 100 ft. in diameter.

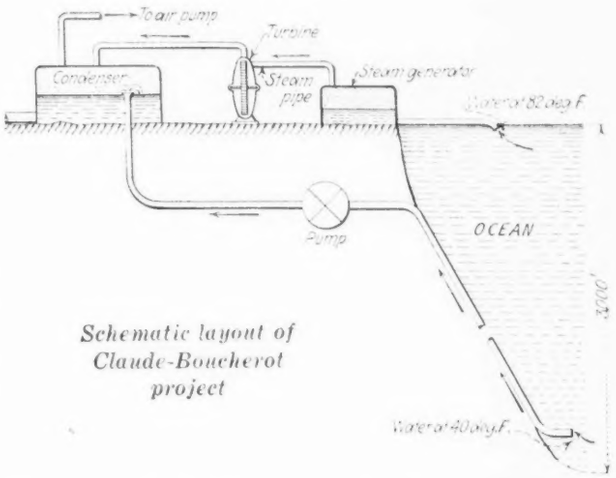
The Turbine Problem

The size of the steam ducts gives an idea of the huge dimensions of a turbine designed to handle efficiently such steam volumes. In order to allow the steam to reach the blading without excessive pressure drop, the inlet diameter should be between 80 and 100 ft., and the rotor diameter would probably be of the order of 90 to 100 ft. Contrary to the usual conditions of turbine design the expansion ratio of the steam is low—less than 2.3. It should then be possible to utilize the energy in one stage, the resultant peripheral velocity of the rotor being between 750 and 800 ft. per second.

Condensing-Water Casing

One of the most difficult design problems in the practical realization of this project would be the construction of the pipe or casing necessary to raise the cold condensing water from a depth of 3,000 ft. It must first provide heat insulation, to prevent heating of the condensing water in its passage through the warm surface water.

Allowing a velocity of 3 ft. per sec., which may be rather high, the diameter of the casing for a 35,000-kw. plant would have to be about 25 ft. Such a structure 3,000 ft. long would be costly. It would probably be necessary to return the outgoing condensing water after



Schematic layout of Claude-Boucherot project

use to a considerable depth, perhaps as much as one thousand feet, by means of another casing, in order to avoid all chance of its contaminating the surface water and lowering its temperature.

Air Extraction a Problem

Among the auxiliary losses that were neglected in computing the available useful energy output, the problem of air removal from the steam generators and condensers, might prove a serious obstacle to the success of the project. Owing to the large quantities of injection water used, and the extremely low pressure conditions obtaining, this problem is far beyond our present experience in power practice. Moreover, the steam ejector could not be used, for lack of high-pressure steam, unless steam were generated in a high-pressure boiler for this specific purpose.

Whereas in ordinary condenser problems, the amount of air to be extracted is usually so small that the mechanical efficiency of the operation is unimportant, the large amount of air entrained by the injection water in this case would make it necessary to reduce the power consumption to a minimum.

Stability of Ocean Currents

One of the unknowns is the stability of the surface and deep water currents, under the drain of the injection-water pumps. The pressure gradients which cause the motion of the warm surface water from the Tropics toward the Poles, and of the cold deep water from the

Poles toward the Tropics, are exceedingly small. What would be the effect of superimposing on these gradients those produced by the suction of the pumps? If water is drawn by the deep-water pumps at a rate greater than that at which the submarine currents can supply it, warm water from lesser depths will be drawn down to the pump suction, and the efficiency of condensation will be reduced. Likewise, if the surface water is pumped at a rate greater than that at which the surface currents can supply it, cold water would be drawn upward to the pump suctions, and the efficiency of vaporization would suffer.

Conclusions

That the Claude-Boucherot project is based on sound scientific principles is undeniable. That its practical realization is *technically* possible seems more than likely. Whether it would be a paying undertaking is a question that cannot be answered without careful study of design details and of local conditions.

Several unknowns are involved in the problem, some of which may prove dangerous to the success of the undertaking. Among these are the construction of the condensing-water casing and of the turbine. It may be necessary to reduce the size of the generating units considerably below the value of 35,000 kw. assumed in order to reduce the size of the structures exposed to the crushing strains of atmospheric pressure. This would increase both the investment per kilowatt capacity and the energy losses in the system; in both cases this would be adding to an already heavy burden. It is conceivable that it might be necessary to reduce unit capacities below the economic limit. The uncertain factors are air extraction and the stability of ocean currents.

However, there is no denying the interest of the proposition. It may be called visionary; yet at a time when the drain on the fuel resources of the world is increasing every year and power users are turning to all natural sources of energy—water, tidal and even wind power—for partial relief, it is interesting to discover an entirely new source, practically inexhaustible, if exploited with judgment, since it is solar energy.

The writer must accept entire responsibility for the discussion and data assumed in this brief study of the Claude-Boucherot project.

Diesel Engine Capacities

In the Jan. 11 issue of *Power* was published a survey of the Diesel engines, showing horsepower sold each year, location by states, etc. This survey has prompted many inquiries as to the sizes of engines sold, leading to a retabulation of the reports on the basis of unit capacities.

While many solid-injection engines of over 500 hp. have been installed, it is generally conceded that below this size the airless-injection engine is in the majority and essentially controls the field. Consequently, it was felt that the classification should segregate those below 500 hp. Likewise, engines from 500 to 750 hp. make up a more or less distinct class. It was also deemed advisable to place units from 750 to 1,000 hp. in a third class. Above 1,000 hp. engine designs show some departures from the design of smaller units. Since engines of above 2,000 hp. must go into large plants and into large motor ships, the classification was made with two more divisions, engines from 1,000 to 2,000 hp. and engines above 2,000 hp. The classification of the data resulted in two tables. Table I shows all the engines sold each year since 1920, while Table II covers marine engines.

In both stationary and marine fields the units under 500 hp. rating make up the major part of the installations. This is not surprising inasmuch as the average power plant, regardless of the kind of prime movers, is

TABLE I—DIESEL ENGINE CAPACITIES

Capacity in Horsepower	1921		1922		1923		1924		1925	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Under 500	157	40,230	277	55,082	567	82,370	566	128,009	1,061	197,830
500 to 750	16	8,100	29	14,440	44	25,520	51	28,735	54	29,980
750 to 1,000	5	4,250	17	13,750	9	7,450	22	18,050	37	29,980
1,000 to 2,000	3	3,000	0	0	9	18,150	5	4,450	24	25,900
2,000 or over	0	0	0	0	0	0	20	45,850	7	20,650

TABLE II—MARINE DIESEL CAPACITIES

	1921		1922		1923		1924		1925	
Under 500 hp.	55	7,275	80	13,600	111	28,965	183	38,220	332	62,805
500 to 750	10	5,400	4	2,000	7	3,700	15	5,400	24	14,690
750 to 1,000	0	0	0	0	0	0	0	0	22	17,600
1,000 to 2,000	5	6,000	3	3,000	0	0	4	5,000	29	12,500
2,000 or over	0	0	0	0	1	2,700	19	43,600	1	2,900

much under 500 hp. That only 352 engines sold since 1920 were above 500 hp., while 2,628 units were below this rating, is due almost entirely to the greater number of the smaller power plants. The fact that small factories do not obtain electrical energy as cheaply as do the large mills undoubtedly has an influence. In addition, the fact that small communities where industrial undertakings are of similar size, cannot obtain cheap power, must not be ignored.

The units from 500 to 750 hp. went into a diversified list of industries, but many were installed in oil pipe line stations, some in central stations, while others went into flour mills, water works, ice plants, etc.

Units of 750 to 1,000 hp. went into similar plants, as did also those between 1,000 and 2,000 hp. Those above 2,000 hp. for stationary service consist mainly of 3,750-hp. units for the Panama Canal Zone, 2,200-hp. units for an Oklahoma mining company, and 2,000-hp. engines for a Nevada copper mine. In Table II it will be noticed that a number of engines of 2,000 hp. and larger are shown. These consist of the Shipping Board contracts, together with engines for private shipping concerns. It is well to note here that the Shipping Board units are included in the 1924 list, while in the survey they were placed in 1925, due to builders' attitude as to when contracts went into effect, but the totals are not affected.

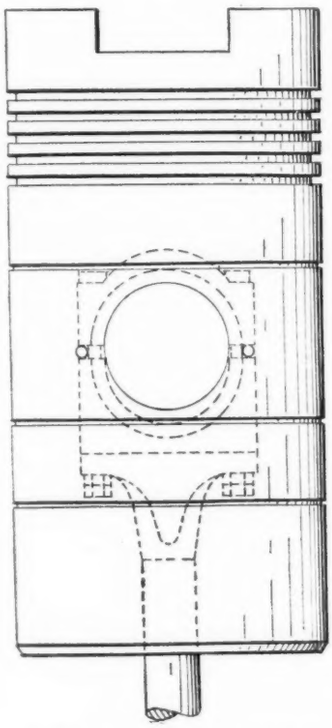
If the Initial Steam Temperature is increased 10 or 11 deg. F., the steam rate of a turbine will be decreased about 1 per cent, and the reverse for a decrease in temperature. But increasing the temperature of superheated steam 10 deg. requires the addition of about 5 B.t.u. more heat per pound of steam, and since making a pound of steam from feed water requires something not far from 1,000 B.t.u., it follows that raising the temperature 10 or 11 deg. requires about ½ of 1 per cent additional heat per pound, so that the corresponding reduction in the heat rate of the turbine is about ½ of 1 per cent.

The January Issue of the *Bulletin de la Société Alsacienne de Constructions Mecaniques* states that this company now has under construction a 40,000-kva. alternator that will operate at 3,000 r.p.m. This machine, which is being built for the Electric Light & Power Station at Strassbourg (Alsace) is rated at 50 cycles and 13,500/14,000 volts.

Tightening a Diesel Piston-Pin Bearing

By A. B. Newell

IN MAKING adjustments to the piston-pin bearings of oil engines of the trunk-piston type, there is sometimes an advantage in doing the job without removing the piston from the engine, or, if the piston is removed to make the adjustment, without driving the pin out of the piston. The advantage is, of course, in the time saved, for the work can be done in a more satisfactory manner by having the connecting rod, bearing and wristpin on the floor or bench so that the pin may be turned by hand, tried for snugness and a general survey be made. When the job is done through the crankcase doors, it becomes one of guesswork, and the accuracy with which it is done depends to a great extent upon the skill, patience and sometimes physical proportions of the mechanic.



Using leads to check piston-pin bearing clearance

If the amount of running clearance is known before the work is started, it is possible to make an accurate adjustment. But since the space within the piston is so cramped that it is impossible to use anything but special wrenches, the clearance cannot be taken in the regular way with lead wire. There is, however, another method that can be employed in most engines without much difficulty.

Taking the Clearance

The position of the nuts should be marked on the wristpin bearing bolts for reference. Then the connecting rod should be disconnected from the crank box and the piston supported within the cylinder by whatever means have been provided by the engine builder. With the rod swinging free, the nuts should be run back on the piston-pin bearing bolts until the bearing halves are apart enough to remove all the shims. These should be carefully marked and set aside as they came out of the bearing.

A small piece of lead, somewhat thicker than the shims will then be inserted in the place of the shims, as shown in the illustration, and the nuts drawn up until the bearing is tight enough to cause the rod to offer a bit of resistance when swung by hand, or until the bearing is as tight as the engineer cares to have it while working.

Slack back on the nuts and remove the pieces of lead and "mike" their thickness as well as that of the shims that were removed. The difference will be the amount to be taken out of the shims; that is, the amount needed to reduce the clearance. In short, the shims, when replaced, should be as thick as the piece of lead that was squeezed down in their place. Care should be taken to draw down evenly on both sides, since the lead, unlike the shims, will not act as a solid filler to hold both sides of the bearing apart the same amount.

The Engineer Should Know His Engine

The engineer who does the work in this way should know his engine. If the bearing halves have been dressed or hammered out of shape and the surface where the shims lie is irregular, the lead will take an impression of such irregularities and its thickness will not be the average thickness of the shims. If the shims are made up of several laminations and are battered and rough, the micrometer is likely to show them to be somewhat thicker than they actually are, for the tension of the bolts will place them under greater pressure than it is possible to apply with the "mikes" and tend to straighten out such irregularities. I have suggested that the nuts and bolts be marked in order to make a general check on such fallacies as this system of taking clearance may have.

In employing the method just outlined, it will be necessary to loosen up the bearing once to take the lead and once to make the adjustment, and since the method may err slightly, it may be necessary to loosen up once more and add or remove a few thousandths of an inch to obtain the final correct clearance.

The method is superior to the one most commonly employed of jumping the piston up and down while the connecting rod rests on the crank box, or jumping the rod while the piston is supported and feeling at the end of the box in an attempt to determine the amount the bearing is slack. On rare occasions this jumping and feeling method helps the mechanic to guess the amount of clearance, but in most instances when the bearing is set up by this method, it is found to be too tight or too loose and the adjustment must be done over again and again until it feels all right when the rod is swung.

It is not uncommon to make one attempt after another with failure following failure until the engineer or machinist doing the work rises up and tells the world at large, and in no uncertain terms, that the job cannot be done. Since he has removed some shims and it is better than it was before, he will let it go until an opportunity presents itself to draw the piston and do the job right. I have experienced a number of such ordeals and I do not blame these men greatly. Working through crankcase doors is not a pleasant job at best, and employing the method outlined I have managed to do a satisfactory job without a great amount of trouble.

Every engineer knows, or should know, that no measurement or mechancial operation can be *exact*, using the word in its absolute philosophical sense. If a carpenter gets the length of a table within a sixty-fourth of an inch it is "exact." The machinist is inclined to call his work "exact" when a slight extra twist on the micrometer barrel brings the proper thousandths graduation to the scratch. Practically the test of skill is to know what degree of precision is worth while for each variety of work.

Modern Soot-Blower Practice

By ROBERT JUNE*

DURING the last several years important advances have been made in boiler design and boiler operating practice in both large and small stations. These changes have, in the main, been widely heralded as far as the boiler itself is concerned. What has not been fully understood and appreciated is that there have been marked changes in operating practice with respect to such important auxiliaries as the mechanical soot blowers. Determined efforts have been made by the leading soot-blower manufacturers to improve the efficiency of their product.

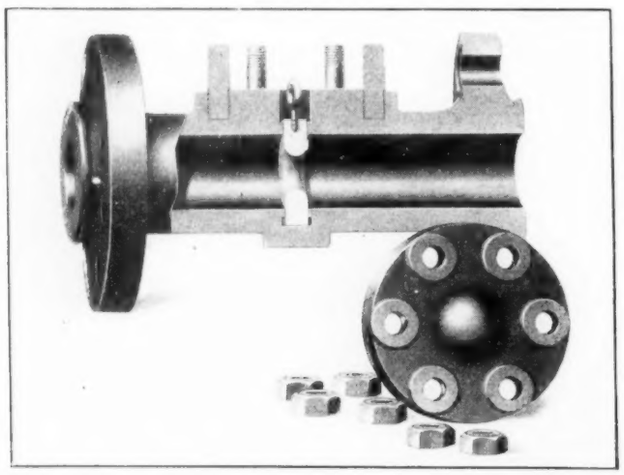


Fig. 1—The orifice fitting substituted for a reducing valve is less subject to service interruptions and wear and works well for reasonably constant flow

Steam Economy Improved

Economy in the use of steam has been developed in several directions. The first and most obvious has been to reduce the pressure at which the soot blowers are operated. As the quantity of steam flowing from a nozzle varies almost directly with the pressure, it follows that the amount of steam projected from a given set of nozzles at 350 lb. gage pressure will be nearly twice as much as that projected at 175 lb.

In connection with lower steam pressures the suggestion has been advanced that it may be possible to secure steam for soot blowers from a bleeder point on the main turbine. Aside from the variation in pressure of extracted steam, there is serious objection to such a system in the possibilities of condensation in the long supply line from the turbine to the boiler setting.

Another suggestion contemplates the use of a reducing valve. It is believed, however, that such valves in soot-blower service would require frequent adjustment if they were to remain accurate and that the maintenance charges would be relatively heavy. A relief valve with a blowoff to some point where the steam could be saved, such as a feed-water heater, would appear more practical than a reducing valve, but would also complicate the system considerably, and it is a question whether operating engineers would look favorably upon any such use of valves.

Pressure-Reducing Orifices

The answer to the problem has been found in the extremely simple arrangement of an orifice fitting where the boiler pressure is higher than that desired for the maximum cleaning efficiency of the blower elements. As shown in Fig. 1, a fitting with removable Monel metal orifice plates, having rounded entrance and exit edges, is connected in the main steam supply line to the soot blower. Much study is being given to the determination of the necessary operating pressure for different boiler conditions and to the reduction of steam

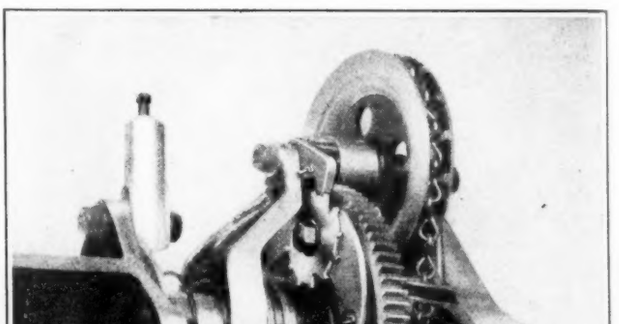


Fig. 2—This automatic lock limits the number of revolutions that can be made without stopping

With each revolution the small ratchet wheel carried by the main gear is advanced one tooth by the pawl attached to the frame. When this pawl reaches a deep notch in the ratchet wheel it drops in far enough to meet a dog attached to the main gear and prevent further motion. The mechanism must be turned back until the pawl is picked up by the next shallow tooth.

*Robert June Engineering Management Organization, Detroit.

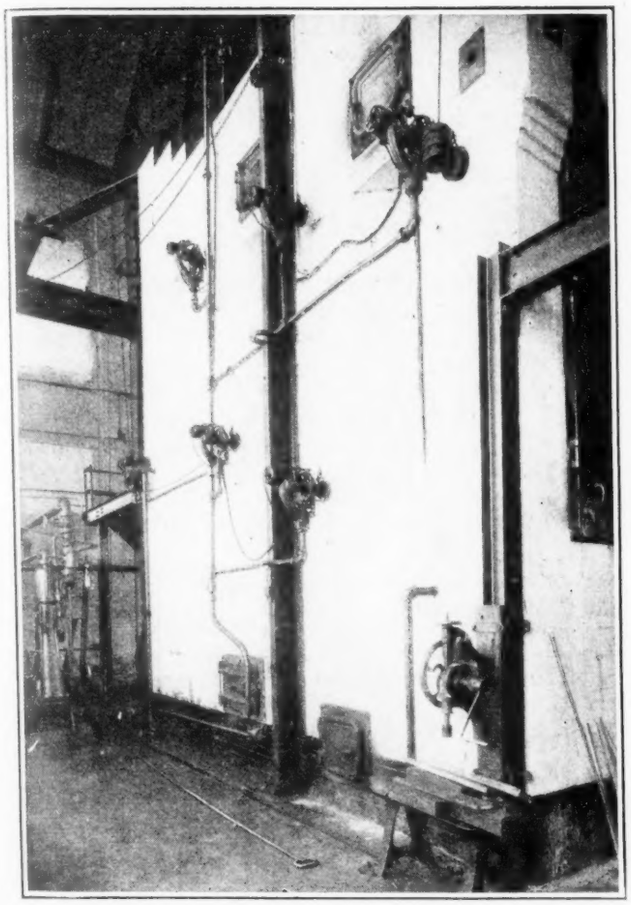


Fig. 3—An early installation of motor-driven soot blowers

pressure to the desired point by orifice fittings of proper size.

The reduction of steam pressure, however, does not represent the greatest potential loss of steam. The real point of attack in the matter of steam conservation in soot-blower operation is the frequency of blowing and the number of blows made.

In this connection economy lies in the use of an automatic valved soot blower, so designed that a saving in steam of 50 per cent or more is effected as compared with the independent-valve soot-blower system. With the independent-valve system the steam is first turned on the unit, then the operator must walk from the valve to the operating chain to revolve the elements and then back again to turn off the steam. With the built-in valve the steam is on only while the blower is in action and does not remain on after the actual blowing has been completed.

Continuous Rotation Saves Steam

One type of soot blower is designed to rotate continuously, sweeping over the blowing arc once in each revolution. The operator may accordingly operate the blower the exact number of times required for cleaning. This is done to save steam. If three blows produce the desired cleaning (and it happens that three is the desired number in many cases) and it is necessary to blow four times to restore the blower to some special off position, the steam consumption is uselessly increased by one-third.

This design is particularly valuable for pulverized fuel fired boilers where the deposits on the tubes are often less tarry or gummy than with stoker firing, and where consequently the tubes can be cleaned thoroughly with a single revolution of the soot blower, thus saving half of the steam in comparison with a blower whose jets have to be passed over the tubes twice before the valve can be closed.

Reference should be made at this point to the efforts being made to determine the correct number of blows for different fuels and varying combustion conditions. For example, tests at Cahokia have shown soot blowers to be just as essential with pulverized fuel as with stoker firing, but it has also been shown, as indicated in the preceding paragraph, that the number of blows can be materially decreased with pulverized fuel, with marked economies in operation. Study of individual conditions is also indicating that it is not necessary in all cases to operate all the soot-blower units on a boiler through the same number of blows. Thus three blows may be required in certain locations, whereas two blows or one will suffice in other parts of the boiler.

Automatic Stop

After the proper number of blows has been determined, the personal equation has still to be taken into account; the operator may or may not limit the soot-blower revolutions to the prescribed number unless some check is placed upon him.

An arrangement developed during the last year automatically controls the number of blows that the operator uses on each soot-blower element. After the

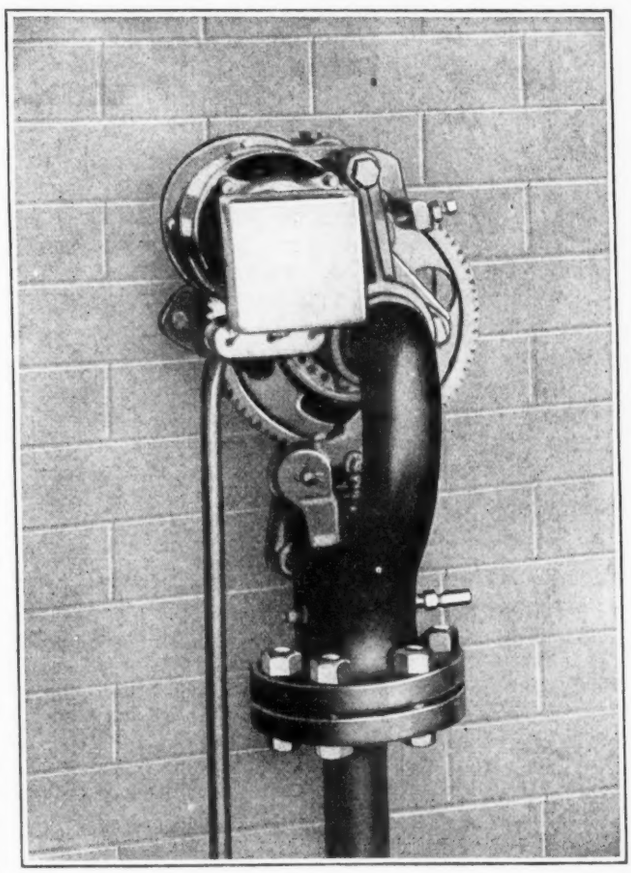


Fig. 4—A modern electrically operated soot-blower head

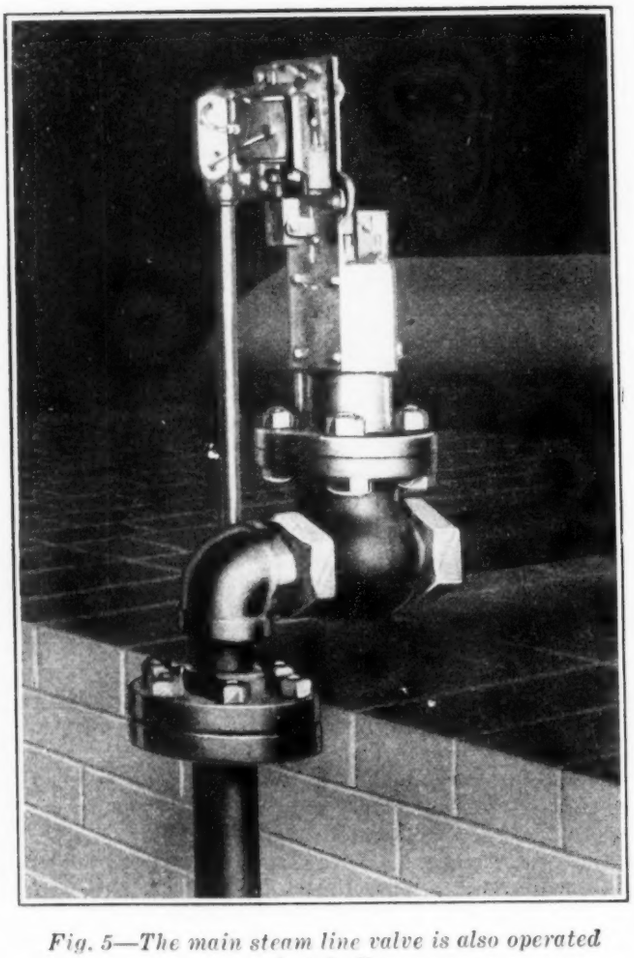


Fig. 5—The main steam line valve is also operated electrically

element has been rotated the number of revolutions for which it is set, the device shown in Fig. 2 locks the blower against further rotation. To unlock the blower, it is necessary to back up on the chain an inch or so, whereupon the operator can go forward again for the specified number of revolutions, at the end of which the device again locks the blower, etc. It is evident that considerable saving in steam can be effected by the use of this device.

The design of soot-blower nozzles has been the subject of study, as has also the effective action of the steam jets in the boiler. In this connection the proper location of elements is a subject to which soot-blower engineers have devoted as much thought as to any single factor. Practice in setting the nozzles relative to the boiler tubes has also been developed along the lines experience has indicated to be the most practical.

Electrically Driven Blowers

A radical innovation is indicated in the design of an electrically operated automatic soot-blowing system, comprising an electrically operated main-line steam valve, motor-driven heads on the individual soot-blower elements, a master controller controlling the operation of the main-line valve and the motor-driven heads, and a starting switch to start operation of the system. Fig. 3 shows one of the first installations of this character, made in Detroit some five or six years ago. Present-day equipment is, of course, more fully developed. Fig. 4 shows a modern motor-operated head. The master controller is so built that it will control the main-line valve (Fig. 5) and the heads in any predetermined manner, operating the several blower units singly or in groups, in any order, and each unit independently for any number of revolutions. The units are piped to the main-line valve, and the operation of these units, as well as the opening and shutting of the main-line and drain valve, may be accomplished by a remote-control operator.

New alloys are now being used for soot-blower elements located in abnormally hot positions in the boiler, which up to this time have either been without soot-blower elements because of the intense heat or have been protected by barriers. This is one of the outstanding developments in the art. At temperatures higher than any encountered in the hottest locations in a boiler setting, the best of these alloys are practically unburnable. They resist satisfactorily the erosive and corrosive action of the boiler gases and the constituents of the ash. Under service conditions it is found that these elements remain straight and readily operative. They so meet all demands as to constitute the practically ideal element.

New Readers, Take Note

Here are the conditions of the *Power* prize contest announced several weeks ago.

1st Prize $500
2nd Prize $250
3rd Prize $100

To be awarded by *Power* for the articles showing the most commendable improvements in the results obtained from the modernization, reorganization or improved operation of a power plant, during the last two years.

If you are a wide-awake engineer, your chances are as good as the next man's.

RULES

1. The manuscripts submitted will be judged on (a) the value of the results, not alone on savings in dollars, (b) ingenuity displayed, (c) general interest and applicability to other plants, (d) method of presentation.

2. The identity of the plant must be revealed in the text and the story must be subject to verification.

3. Articles should be as short as consistent with telling the facts; preferably not exceeding 4,000 words exclusive of illustrations, which are desirable.

4. All manuscripts should be submitted by May 15, addressed to *Power*, Tenth Ave. at 36th St., New York, and plainly marked "Entered in Power Prize Contest." The manuscripts should not be signed but each should be accompanied by a letter of transmittal giving author's name and address. For the purpose of judging, such letters will be keyed to the manuscript and filed.

5. Articles which do not win prizes, but which possess sufficient merit to warrant publication, will be used subsequently and paid for at regular rates.

6. The competition is open to all without regard to position.

7. Names of the judges selected by the editors will be announced later.

Know Your Plant

DO YOU know your plant? You answer, "Of course I do." Are you sure? Strange things have been uncovered now and then. Are you sure that no clean distilled drip water is going to the sewer? Are you sure that hot water is not going into cold-storage tanks? Are you sure that cold water is not entering the hot storage?

It pays periodically to wipe out your memory, as it were, and go over your plant with the eyes of a stranger, studying equipment critically and tracing every inch of piping.

A plant that is just right is a slow growth, and the growth is a matter of eternal vigilance. It pays to go about systematically now and then, looking for things little and big that might be changed to advantage: A valve that is hard to get at or leaks badly; a bit of hot piping that might be covered; a bearing that should be taken up a bit; an old waterline that should be looked into for excessive corrosion; an old engine that should be taken down for a thorough internal inspection for wear and leaks.

And don't assume that the general plant layout is right because it is old. Make up a complete diagram of piping and equipment, and then stand off and look at it. It may not look as good as you think it is. In a larger plant this is a good job for a new man who knows nothing about the plant. He will learn a lot and is quite likely to uncover some surprises for the older men on the job. In several cases such men have found a number of things that everybody else knew were not so.

However the job is handled, it is a good job, and it is not a bad idea to go about it now, before the heating season is over. It is easier now to distinguish hot and cold water lines, drip lines and the like, and to trace their course. And whatever is found that should not be, can be set down on the docket of work for the summer months.

Try it!

Difficulties of the Consulting Engineer

WHY men after years of preparation and practice desert their profession of engineering for other lines of activity is a live question and has given rise to columns of letters and comments.

While financial inducements are often the motive, in a majority of instances the desertion is due to the ever narrowing field of usefulness within which the independent professional engineer finds himself compassed.

The professional engineer who attempts to pursue his vocation independently, faces competition from various sources. Consolidations and financial interlocking of power companies and large industrials have resulted in centralized engineering staffs within the companies, which have taken over work formerly handled by outside consulting engineers. Again, free engineering service, as an adjunct to commercial sales, is becoming well established. As a result the engineer is forced to abandon his profession or become a more or less unimportant unit in some commercial organization, where engineering advice must too frequently be cut to meet the exigencies of the occasion. If his manhood is not destroyed, at least his professional self-respect may suffer a partial eclipse.

This condition, happily, does not exist to so great an extent in other professions, and both lawyers and doctors largely carry on independent practices. Although the man with a physical or legal ailment can safely depend upon obtaining unbiased advice, when he has an engineering problem, the story may vary. He may be considering the problem of power-plant enlargement and frequently must make a choice between the consulting engineer, the equipment engineer or the commercial engineer of a utility seeking to sell power. All these three may be honest, but it is difficult to form an unbiased opinion in matters where one's own interests are at stake. If each made the same charge for the service rendered, the independent engineer would have little complaint, even though the second party in the negotiation might not be obtaining as unprejudiced advice as he thinks. The difficulty is that it is human to like the gift in preference to the article for which one must dig into the pocketbook. If engineering services are worth while, they are worth a fair price.

Fuel Consumption Not the Only Factor

ENTIRELY too much stress is placed by builders and purchasers of Diesel engines upon the fuel consumption.

Every engineer has in the background considerable experience with, or at least knowledge of, steam engines. Inasmuch as the water rates of steam engines vary as much as two or three hundred per cent, obviously when bids were under consideration the items covering the guaranteed steam consumptions received the closest scrutiny. Sometimes the price of a unit having a high water rate was so low as to prompt its purchase to the eternal regret of all connected with the power plant. It was but natural, then, that builders of economical steam engines placed the greatest emphasis on the water rate, and the engineer finally incorporated this into his buying theory.

Internal-combustion engines present an entirely different problem, for the fuel consumptions of any two engines of any particular type, regardless of the makes and peculiarities of designs, are almost identical. As an example, Diesel engines in sizes ranging from ten horsepower to ten thousand horsepower do not show a

variation in fuel rate of more than ten per cent, and this holds true for all the various types.

It is manifestly of little value to set up fuel consumption as a standard of comparison. Other criterions must be used when examining oil engines, of which reliability is the most important.

Just how reliability may be determined is most difficult to outline. Certainly, the builder's shop organization and his ability to embody superior workmanship are influences, but how a comparison is to be made is another story. As reliability exists only where the maintenance is at a minimum, an excellent way of judging engines is by the maintenance, both that known to prevail in existing plants and that made apparent through a study of engine design.

A Power Supply for Electrically Driven Auxiliaries

A MUCH discussed question in power-plant design is how best to supply power to motors driving the essential auxiliaries. A number of methods have been suggested and used, but so far no standard practice has been adopted. In fact, in some important plants turbine drives have been selected, which of course eliminates the problem of power supply for motors on the more important auxiliary. The main units cannot be any more dependable than their auxiliaries, therefore it is essential that these be made as reliable as possible. It is not good business to have a unit that costs one-half million dollars or more shut down because some auxiliaries that cost a few thousand dollars failed.

On account of the higher efficiency of the main units, there has been a tendency to put all the station load on these machines. To do this has in general involved two methods, one to supply the auxiliaries from a generator driven from an extension of the main generator shaft and the other to connect transformers directly to the generator leads. With the shaft-end generator the auxiliary power is not only supplied from the main turbine, but is also isolated from the main generator. These features are desirable, but the auxiliary generator increases the length of the unit, which raises some valid objections. The auxiliary generator runs at the speed of the main unit, which is generally far below the speed for which it would be designed if it were an independent machine.

With transformers connected to the generator leads, there is a tendency to consider this as endangering the reliability of the main unit. There is a school of thought that considers that the transformer is the most reliable piece of electrical equipment there is and, that when properly connected to the main generator it improves the dependability of the whole machine over that obtainable when an auxiliary generator is used. There is much in favor of this thinking. If the transformers are properly designed for the service, they have a high degree of reliability and they can be protected so they will not endanger the main unit. The windings, being immersed in oil, will maintain a more stable insulation condition than those of the auxiliary generator which may be subjected to all the effects of being exposed to the atmosphere.

Should the transformers fail and shut the machine down, they can be disconnected from the main unit by pulling the disconnect switch, and the motors can be connected to an emergency auxiliary power supply, thus making the machine ready for service again. With the auxiliary generator, it must be disconnected from the main unit before the machine will be ready to go into service again, which will require a considerably longer time than to disconnect the transformers. If the exciter is connected on the out end of the auxiliary generator, this must also be provided for before the machine can go back into service. A complete analysis of this problem will bring out many other features, but it is evident that those who advocate the use of transformers have some desirable factors in their favor.

Power from the Tropical Ocean

YEARS ago Jules Verne let his fancy roam over the ocean and beneath its surface. As a lover of scientific wonders he penned a story about a great submarine boat in which adventurous men explored the marine gardens and cruised through strange seas. Strange to say, many of his fancies grew into facts. The same has happened time and again to other dreams, until now pretty nearly everybody is cautious about saying that this or that can't be done or even that it can never pay.

Nevertheless, it must be admitted that not all dreams come true. The path of engineering advance is strewn with the wrecks of projects promoted by telling of other projects that succeeded in spite of pessimists.

One fears that this may be the ultimate fate of the plan of two French scientists, Georges Claude and Paul Boucherot, to extract power from sea water. They propose to drive a turbine by vapor from the warm surface waters of the tropical ocean, allowing the vapor to pass through a low-pressure turbine to a condenser cooled by cold water pumped from a great depth. An over-all temperature range of about forty degrees would thus be made available.

Had it not been for the admitted scientific standing of these men, the whole proposition would have been dismissed as another engineering pipe dream. Under the circumstances it has seemed worthy of serious, if not enthusiastic, consideration.

In this issue, R. H. Andrews, Paris Correspondent of *Power*, plays around with the idea, making a few assumptions and calculations upon which he bases a tentative appraisal. Mr. Andrews concludes that the plan may possibly be feasible technically, although by no means easy of accomplishment. Practically, it might be wrecked on any one of several difficulties. To mention just one, the rotor of a 35,000-kilowatt unit would apparently require a diameter of about one hundred feet. Others are discussed in Mr. Andrew's article.

All things considered, tropic seas appear to offer pretty poor fishing to those seeking new and economically workable sources of power, but occasional daydreaming of this sort is a harmless diversion and may lead now and then to results of great practical importance. In this case one must not overlook the possibility that the proposal may be ingeniously modified to dodge some of the mountains of difficulty that now stand in the path of commercial success.

A LOAD SURVEY made on a large power system showed that the majority of the motors were loaded at fifty to sixty per cent of normal rating and in only about fifteen per cent of the cases were they carrying near full load or more. From this it is evident that there is a real need of information on which to base the loading of this class of equipment.

Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted.

Water-Measuring Tanks for Test Purposes in the Small Plant

The illustration shows a water measuring device that we have recently installed in our plant for test purposes. The measuring tanks are so arranged that the condensate from any one of the three generating units on the weight of water being fed to any one or all of the boilers can be accurately measured. The outfit also provides a ready means of checking the accuracy of the V-notch meter on the heater.

The tanks (No. 1 and No. 2) are built of heavy galvanized iron and reinforced with bands. They are designed to hold 50 lb. of water (at 62 deg. F.) per inch of height, or a total of 2,500 lb., when the water level is close to the top of the gage glass.

The open tank *A*, which has a slightly greater capacity than the measuring tanks, is inserted in the suction line so that a measuring tank can be drained quickly and to assure the tank being empty before the valve *B* is closed. The handles for the valves *B* are extended as shown in the detail to facilitate their operation.

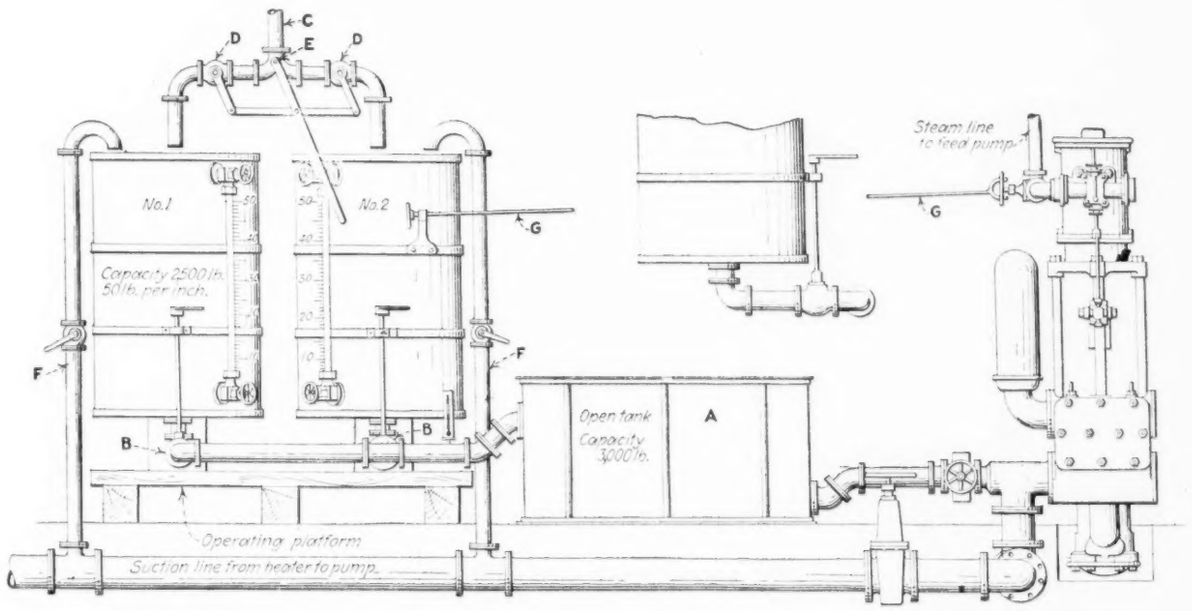
The 3-in. line *C* is connected to the main condensate header, and the water to the tanks is controlled by the cocks *D*, which are so coupled to a single operating lever, hinged at the point *E*, that when one cock is open the other is closed. The cocks are of the single-pass quarter-turn type with iron bodies and brass plugs.

When running an evaporation test on the boilers or checking up the meter on the heater, the water is supplied to the tanks through the risers *F* from the main suction line to the pump, the elevation of the heater being such that there is sufficient head on the suction line to raise the water into the tanks.

When using the tanks, the regulator controlling the steam to the pump is disconnected and the speed of the pump is controlled by the man operating the valves on the tanks. In order that this may be done conveniently, an extension stem *G* is carried over to the tank so that all the controls are within easy reach.

As it is difficult to build the tanks so that they will hold exactly 50 lb. per inch of height, it is necessary to calibrate them and arrange the graduations on the gage glass after they are in place. This is best done by weighing the water in some convenient vessel on platform scales and pouring it into the tank until the total of 2,500 lb. has been weighed out. If the level does not quite reach the 50-in. mark, the scale can be divided into any equal number of parts or if desired a piece of board of suitable size can be fastened to the side of the tank to bring the water to the proper level. This has the advantage that the strip can be planed down to the exact size required to give the 50-in. depth, then the scale can be divided directly into inches. Before filling the tanks for calibrating them, water should be poured into the connecting piping until it overflows into the open tank. This will leave the piping full and the water level with the connecting flange on the bottom of the measuring tanks.

As previously mentioned, the tanks were designed to hold 2,500 lb. of water (at 62 deg. F.) per inch in height. This calls for a cross-sectional area of 1,385



Arrangement of measuring tanks for condensate from turbines or feed water to boilers

sq.in., or a diameter of approximately 42 in. As it is practically impossible to make the tank to the exact diameter required, it is best to make the diameter slightly larger, say 42⅛ to 42½ in. and finally calibrate the tank by actually weighing the water and inserting a wooden strip in the tank to reduce the area to the required figure as already described.

As the temperature of the water will vary over a considerable range, correction must be made for the average temperature shown during the test period. The percentage to deduct from the weight as shown by the tanks is given in the following table:

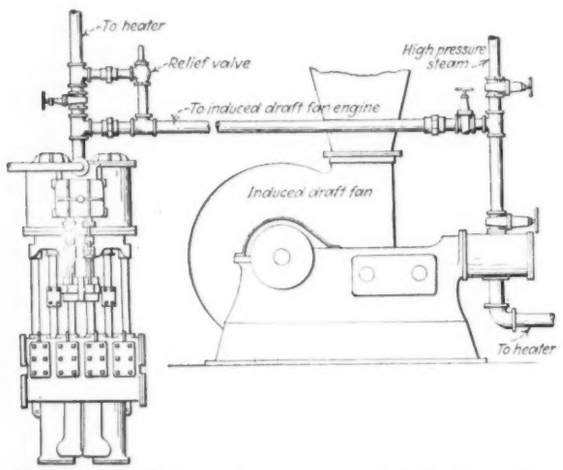
Temperature	Per Cent of Weight to Deduct	Temperature	Per Cent of Weight to Deduct
62	0	120	1.0
70	0.08	130	1.2
80	0.2	140	1.6
90	0.4	150	1.9
100	0.5	160	2.2
110	0.7		

New York City. A. L. COLBURN.

Exhaust of Feed Pump Used to Drive Fan Engine to Reduce Temperature in Heater

While I was visiting a certain power plant recently, the engineer outlined to me some changes he had made in an endeavor to increase the economy of the plant, some of which seemed to me rather unusual.

As most of the auxiliaries in the plant were steam driven, considerably more exhaust steam was being passed to the open heater than could be utilized and much was lost to the atmosphere. As economizers were also in use, this temperature was much too high to get the best results. To further aggravate the trouble, the plant was being operated much below its rated capacity, and as none of the auxiliaries with the



Exhaust of fed pump was connected to steam line of fan engine

exception of the feed pump was controlled automatically, much steam was wasted through failure on the part of the operators to adjust the speed to suit the load.

One of the first changes the engineer made was to connect the exhaust of the feed pumps to the live-steam line supplying the induced-draft fan, as shown in the illustration. This arrangement appeared to work satisfactorily and not only did it reduce the total steam required to operate the two units, but the speed of the fan was regulated by the speed of the pump, which, in turn, was controlled by a float in the heater.

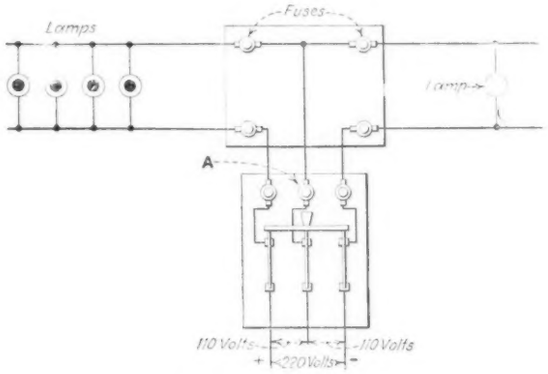
Another practical idea he had put into effect to lessen the amount of steam to the heater was in connection with the installation of an evaporator. The evaporator has been placed adjacent to a 5,000-kw. unit, and the steam was taken from the first stage of the machine at approximately 50 lb. pressure and the exhaust of the evaporator returned to the turbine again at the atmospheric stage. The machine being in continuous operation about 330 days a year, this arrangement worked well.

Upon looking over the plant more or less closely it was apparent that the economy was about all that could be expected, as the equipment was well maintained and the exit gas temperature was below 400 degrees.

Buffalo, N. Y. G. L. ALEXANDER.

Effects of Opening the Neutral on a Three-Wire Circuit

Where the neutral wire of a three-wire 110- and 220-volt system is fused, there is always the possibility of the fuse blowing and causing the voltage to be much higher on one side of the system than on the other.



Two circuits supplied from a three-wire line

This will be made clear by referring to the figure, which shows one circuit of four lamps connected to one side and another circuit of one lamp connected to the other side of a three-wire line. As long as the neutral fuse *A* is complete, the difference in current taken by the two sides of the line is carried by the neutral wire and the voltage of the two circuits remains nearly the same.

If the neutral fuse opens, then the circuit is from the + side of the line through the four lamps in parallel, then through the one lamp on the other circuit to the — side of the line. The same current must flow through one lamp that flows through the four, so that the single lamp will burn very brightly and may soon burn out, whereas the four lamps will be dim. Since the four lamps are in parallel, their joint resistance will be one-fourth that of one lamp. As the current is the same through the single lamp as through the four, the voltage drop across the one lamp will be four times that across the four in parallel.

Whenever the lamps on one side of the circuit burn more brightly than they do on the other, it is a good indication that the neutral wire is open at some point. In the earlier days of the electrical industry it used to be common practice to fuse the neutral wire, but this has changed to the unfused neutral. However, this does not entirely eliminate the trouble, since a loose connection or a broken wire in the neutral will have the same effect as a fuse blowing.

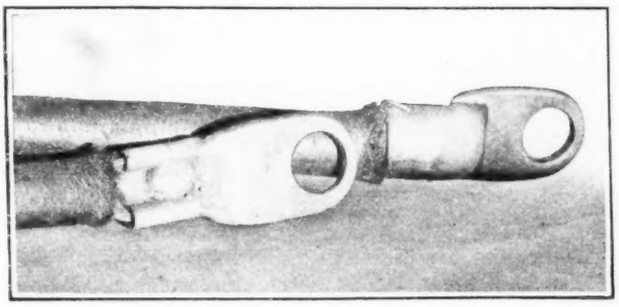
Baldwinsville, N. Y. A. J. CHRISTOPHER.

Comments from Readers

Welded Lugs for Arc Welding Cables

Soldered lugs on power cables have been used for many years, and many electrical men seem to be of the opinion that soldering is the only practical method of attaching lugs. An interesting refutation of this belief is found on the latest type Lincoln Stable Arc Welders, which have the lugs welded to the cable end. On arc-welding equipment the nature of the work is such as to subject the equipment to occasional severe overloads and reliability of operation is of paramount importance.

With the welded lugs the current-carrying cables can be run hot enough to burn the insulation completely off



Lugs welded to the cables

without endangering the lug connection. It will be noted from the illustration that the cable strands are held mechanically in the copper lug and that the weld is made primarily to give a solid-copper path for the current.

While in some cases it may be advisable to have the soldered lugs on overloaded cables melt off, it would seem possible that welded-copper lugs might have a legitimate field of application outside of arc-welding equipment, plating equipment and similar heavy-current devices. It has been suggested that the welded lugs and connections might be used advantageously on electric-furnace equipment, heaters, etc.

Cleveland, Ohio. R. E. KINKEAD, Engineer,
The Lincoln Electric Co.

An Engine-Room Heating Problem

In a cold climate the heating of a Diesel engine room is quite a problem. Recently, the reading of the article, "Some Thoughts on the Installation of Oil Engines," in the Dec. 21, 1926, issue of *Power*, set me thinking that there must be some advantage in taking the inlet air outside of the building. In figuring out a certain installation, I found that an engine having 12x18½-in. cylinders operating on the four-stroke cycle at 257 r.p.m. was taking approximately 151 cu.ft. of air per minute into each cylinder, and since the engine in question had five cylinders, the total air consumed was equivalent to 775 cu.ft. per minute.

The dimensions of the engine room are roughly as follows: 35 ft. long by 25 ft. wide, and 25 ft. high. This gives a volume of 21,000 cu.ft. Therefore, the room was being emptied at the rate of 21,000 ÷ 775, or once about every 27 minutes. With the temperature of 30 to 35 deg. below zero, as existed some weeks during the winter, it was extremely difficult to keep the engine room warm. Since the air intake has been taken outside, we have no trouble whatever in keeping the room comfortable.

I anticipated trouble with piston lubrication with such cold temperatures coming in contact with it, but as yet we have experienced none, even with the thermometer recently registering 42 deg. below zero outside.

Kamsack, Sask., Canada. JAMES M. BLOOMFIELD.

This Assistant Engineer— What Can He Do?

I noticed in *Power*, Feb. 1, F. P. Terry's article on the assistant engineer.

Personally, I do not see how Mr. Terry's friend has any kick coming whatever. He was given to understand that old Andy was to be chief as long as he was able to give his attention to the plant or even a portion of his time to looking after the general welfare of the engine department. The fact that old Andy was well along in years had nothing to do with the time when this assistant was to be given the position of chief engineer of this particular plant. He was to learn every detail and working condition, say nothing and saw wood until the old man had either retired of his own volition or was carried to his last resting place.

This assistant is handicapped at every turn. He is anxious to make improvements in his plant and could make great savings, but when he approaches the directors, he is told that the matter will be placed before the old chief. From this point he rarely hears anything further.

One great mistake the average assistant makes and that is to go over his chief's head and try to make the management believe that he can make changes that will work wonders in economy. It is more than likely that the chief has already thought out all the changes his assistant has taken up with the management and has figured the cost, time lost in making the changes and the saving after the changes have been made, but has found that it would be robbing Peter to pay Paul.

At any rate, if the management has any confidence at all in the chief, and this management seems to have, the assistant is only wasting his time. The person to whom he should put his improvement theories is his chief, and if there is anything in them, his chief will most likely take them under consideration.

If this assistant is so cocksure that he can improve steam plants in economy and is not willing to wait for the old chief's demise, he may do well to move on to some other plant. There are many concerns looking for such engineers. It is said that a rolling stone gathers no moss, but it does gather a lot of experience that may

be the means of helping the moss-gathering stunt once the stone finds a good resting place and stops rolling.

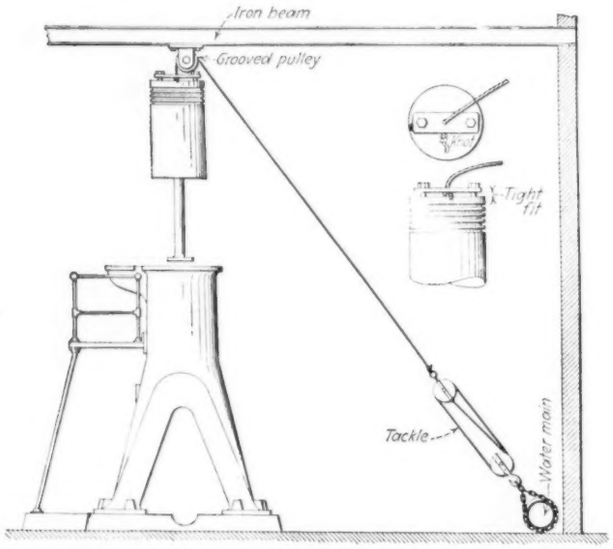
However, if conditions are as Mr. Terry describes them, the old chief can hardly hang on more than ten or fifteen years longer and it may be well for his friend to hang around for awhile. Some one has said that consistency is a jewel, but it is my opinion that if consistency is a jewel, patience is two jewels. I imagine waiting for someone to die in order to get his job would make time pass very slowly, but someone will have to do this waiting, so why not the assistant?

Staunton, Va. J. W. STEPHENS.

Pulling Oil-Engine Pistons

When reading the article on the installation of oil engines on page 951 in the Dec. 21, 1926, issue of *Power*, the last paragraph on headroom especially arrested my attention, for it reminded me of a similar experience.

Several years ago I was employed in a power plant where a vertical gas engine, direct-coupled to a generator, was installed. The engine room was rather low,



Pulling a piston when the headroom is small

but with a view to facilitate the withdrawal of piston and connecting rod, the generator was placed flush with the floor level. This was not sufficient, as the piston and rod could be pulled together only by frequently changing the point of application of the crane hook and swinging the piston in a downward direction. It was quite a job, and owing to time limitations we were compelled to devise a special rigging.

In the first place the use of the crane was abandoned and a small pulley was bolted to the ceiling of the engine room. A long piece of wire rope was connected to the eyebolts on top of the piston and thence to a tackle fastened to a heavy pipe on the engine-room floor, as shown in the illustration.

Then it was easy enough to raise the piston very close to the ceiling, but in order to free the connecting rod entirely from the top of the cylinder liner, it was necessary to remove the eyebolts and replace them by a shorter connection. The end of the wire rope was inserted in a hole drilled in the center of a bar and the two capscrews pulled down to clamp the wire.

Enschede, Holland. H. W. LOOS.

Advantages in Precooling Ammonia

The article of William Jehnke in the Jan. 25 issue on saving to be expected by precooling liquid ammonia, was quite interesting, but I think his contribution would have been more convincing if figures had been used to demonstrate how heat in the precooling coil in accumulator is taken up, or how the compressor work is diminished by precooling the liquid by ammonia in the accumulator. The impression is left that one gets the precooling for nothing.

It does not alter the heat content to be handled by the compressor in either case; that is, whether the excess heat in the liquid is taken up in the evaporating coils or in a precooling coil.

His figures show that a 100-ton ice plant will do 107 tons by precooling the liquid, but they do not bring out how the heat equivalent of this seven extra tons, supposed to be gained, is taken care of.

St. Louis, Mo. M. H. MILLS.

Limitations in Oil-Engine Efficiencies

The editorial of the Nov. 30, 1926, issue entitled, "Why be Satisfied with Existing Efficiencies?" calls attention to less effort now being made to improve the fuel economy of the compression-ignition engine than is being applied to the steam-using prime mover. There is, furthermore, mention of commercial limitations for the Still engine owing to its unconventional design. The editorial is timely. Before expanding, however, upon desired compression-ignition engine development, it may be well to recall some broad distinctions between steam and internal-combustion engines.

The steam plant, since it involves more physical processes, is naturally more complex, and hence open to greater range of investigation and improvement. Besides, the steam plant has, up to the present time, been able to utilize a greater variety of fuel. In variousness of features and accessories the steam plant exceeds the internal-combustion engine. Fortunately for the further development of the steam plant, the present generation of engineers takes such conglomerations of adjuncts and accessories as simply natural. This gives stage bleeding for feed heating, multiple reheating effects, mercury turbines, and binary-fluid prime movers the appearance of being in, or eligible to, good engineering standing. It comes to mind, however, that were the compression-ignition engine as universal in its ability to handle solid, liquid or gaseous fuels as is the steam plant, and could it be obtained in something like as large units, then the present steam plant would not be the thing of pride it now is in engineering eyes.

Prime-mover development may be considered under two heads—direct improvement in thermal efficiency, and indirect improvement. A direct improvement is such as can be derived from an increase in compression, an improvement in combustion or increased ability to handle a cheaper fuel. An indirect improvement is such as comes from heat reclamation measures like the utilization of the heat in the jacket water and the exhaust.

It is noteworthy that while the compression-ignition engine has not made any revolutionary direct improvement in a quarter of a century, the steam turbine has done no better. Both these plants have been and are still attempting to resort to heat reclamation schemes. It would appear that the innovation needed in the devel-

opment of a compression-ignition engine, is ability to handle the cheaper and more widely obtainable coal; a fuel whose commercial standing is not likely to be increasingly dominated, in this country at least, by the legitimate demands of one large class of consumers.

Commendable as are heat reclamation measures for any type of prime mover, the advantage of the direct over the indirect improvement in heat efficiency, deserves consideration. For example, consider an oil engine that requires 10,180 B.t.u. per b.hp.-hour. The thermal brake efficiency of this engine would be 2,545 ÷ 10,180, or 25 per cent. Now, with this same input of heat, if an improvement in compression or in combustion could bring about an increase in delivered work equivalent to 500 B.t.u. per hour, then the thermal brake efficiency would become (2,545 + 500) ÷ 10,180, or 29.9 per cent. The result is a gain of 4.9 per cent in brake thermal efficiency, which means a 4.9 per cent gain in delivered work from the same heat input.

Consider next the gain in thermal brake efficiency of a plant when this efficiency is improved by some heat-reclamation scheme that results in a net reduction of 500 B.t.u. in the chargeable heat input per b.hp.-hour. Instead of the plant expending 10,180 B.t.u. per b.hp.-hour, it will now require only 10,180 — 500, or 9,680 B.t.u. The corresponding thermal brake efficiency would be 26.3 per cent, an improvement of only 1.3 per cent, and this assumes that the 500 B.t.u. reclaimed are a complete saving, with no incidental losses or efficiencies involved. On this same basis the denominator of the efficiency equation would have to be reduced to 2,545 ÷ 0.299, or 8,510 B.t.u., a reduction of 1,670 B.t.u., in order to make the same gain in efficiency by a reclamation scheme as by a direct gain in delivered work of 500 B.t.u. The magnitude of the heat quantity, 1,670 B.t.u., is indicative of the necessary capacity of the reclamation apparatus and the effort involved. For the same gain in thermal brake efficiency the heat to be dealt with in the indirect improvement is 1,670 ÷ 500, or 3.34 times as much as for the direct.

But suppose the 1,670 B.t.u. were reclaimed from the piston, jacket water and exhaust of a Still engine. This reclamation would be of no avail for improving the thermal brake efficiency till means were provided to utilize in some form of prime mover the steam generated by this heat. If the 1,670 B.t.u. be considered as the net output of the exhaust-gas boiler, there is still to be considered the losses incidental to the steam cycle executed on the steam side of the piston. If the over-all efficiency of this steam end is assumed to be 20 per cent, then the actual gain in work is equivalent to only 334 B.t.u.

The same expenditure of ingenuity and mechanism, if applied to obtain a direct gain in efficiency, should, it would seem, bring about increased ability to handle a cheaper fuel than is now in favor or else justify a measure of chemical or other treatment of the unfavorable fuels. Should the internal-combustion engine become able to burn coal satisfactorily, it is probable that such reclamation measures as used in the Still engine, would become unattractive. Likewise, wide use of the exhaust-gas turbine might be postponed indefinitely.

Unfortunately, appreciable gains in fuel economy from direct improvements are not in sight. Difference in area of the actual indicator diagram and the ideal air diagram, as pointing to possible room for improvement, may be somewhat misleading. After allowing for variable specific heat, it is doubtful if more than 15 per cent of the theoretically available heat of the fuel remains to be converted into indicated work by further improvement of the best commercial engines. And this does not mean 15 per cent of the heat in the fuel, but 15 per cent of the work represented on an ideal diagram. Furthermore, the effort to obtain this last 15 per cent would be no exception to the common experience in obtaining last portions of refinement.

Determination of the feasibility of the coal-burning compression-ignition engine, of the judicious amount of attention to preremoval of ash, of the limiting r.p.m. as dictated by time required for combustion, seem highly desirable. Present alarms seem to be about the ash. The relatively long time required for processes associated with combustion compared with the amount of time the desired r.p.m. provides, may, as with the automotive oil engine, prove more formidable than expected during commercial development. But as regards the ash, suppose central stations using steam had heretofore known only the use of oil fuel, could anyone hope to sell the idea of a combination of coal conveyor, stokers, clinker grinders, and ash removal equipment?

Perhaps wider familiarity with the somewhat increasingly elaborate fuel and ash handling systems in steam plants may make the essentials of the coal-burning engine appear less formidable. And when one views the numerous apparatus of a steam plant, with many pieces having a multiplicity of parts, it does seem as if too much emphasis has heretofore been laid solely on the cost of engines. When the coal burner comes up for consideration it is to be hoped that a sufficiently wide-angle lens will be in evidence to include with clearer vision the significant relation between price and breadth of market.

The knowledge now possessed of the limits to the over-all efficiency of the oil engine, wide distribution, price and, apparently, greater independence in the price of coal as compared with oil, and the conglomerated designs that are being presented for improving the thermal efficiency of heat-using prime movers, point to both the scientific and commercial wisdom of research development of the coal burner. The narrow margin for improvement of the thermal efficiency of oil engines, puts the oil-engine developer at an unfair advantage in trying to make engine development keep pace with fuel prices which, instead of taking years to be determined, as are his efficiencies, can be arbitrarily altered over night by sales departments and agreements. Besides, the urgent demand for kerosene and gasoline cannot be countered in the oil market by ingenuity in the improvement of oil engines, even though such might seem to be a scientifically reasonable course to pursue.

There is, of course, to be considered the relative cheapness of research and development work abroad as compared with at home. However, with Germany considered as the most likely birthplace of the coal-burning engine, it should not be overlooked that Germany was somewhat slow to allow the merits of airless injection and to confess the complexity of the home-born air-injection engine. When it comes, therefore, to the determination of commercial feasibility in a broad field as compared with technical feasibility, it might, perhaps, be well for some work to be done the results of which shall be native to the engineering attitude and conditions at home.

ROBERTSON MATTHEWS.

Detroit, Mich.

Steam-Pressure Regulator for Extraction Engines

THE Jan. 21 issue of *Engineering* described a new type of automatic pressure regulator as applied to a pair of 600-i.hp. compound engines installed in a British plant. Steam is extracted or bled between the high- and low-pressure cylinders. This regulator is designed to keep the extraction pressure constant, regardless of the load on the engine or the demand for process steam. The following description and the accompanying cut are based on the article in *Engineering*.

The complete plant was supplied by Messrs. Galloways, Ltd., Manchester, to a bleach works where there is a large but variable demand for heating steam. The main interest in this installation lies in the regulator, which is of a novel type recently introduced by the firm. It forms a unit complete in itself, and can be installed almost anywhere, and for a wide variety of purposes calling for pressure regulation.

The design of this controller is such that close regulation of the steam pressure is possible, but in general practice it is usually sufficient to maintain constancy of pressure within a margin of ½ lb. to 1 lb. per square inch.

In the case of an extraction engine it is essential that the speed of running shall be controlled by the ordinary governor and maintained constant whatever the demand of the factory for heating steam. To this end the cutoff in the high-pressure cylinder is controlled solely by the ordinary governor, while the regulator adjusts the cutoff in the low-pressure cylinder by means of a servo-motor so as to maintain the steam pressure desired in the extraction mains. The valve that adjusts the supply of pressure oil to the servo-motor is operated by a weight floating on mercury, and the level of this mercury is controlled by the pressure in the extraction mains.

Steam from these is admitted to the regulator through the pipe *A*, Fig. 1, and passes through the spring-controlled surplus valve *B* to the interior of the chamber *C*. This chamber is closed at the top by a cover, and is provided at the bottom with a leak off to atmosphere through an opening, the area of which can be adjusted by the handwheel *F*, Fig. 2. A second handwheel at the top of the cover serves to adjust the tension of the spring *D* by which the surplus valve *B* is loaded.

In normal running there is always a slight flow of steam through *B* into the chamber *C*, and thence through the leak off to the atmosphere. Should the pressure in the supply pipe *A* rise, it forces the valve *B* farther open, and since the leak off is unaffected, the pressure in the chamber *C* rises a little, and in doing so depresses the level of the mercury in the tank *H*, expelling it through the opening shown at *K* into the float chamber *L*, which, it will be seen, communicates with the atmosphere.

The iron float *J*, which is fitted with anti-friction guides, is coupled to one end of a floating lever, as shown in Fig. 2. The other end of this floating lever is connected to the pilot valve which controls the supply of pressure oil to the servo-motor shown near the bottom of the standard.

The piston rod of this servo-motor is coupled up by the levers and cranks indicated to the fulcrum of the floating lever. An overtaking motion is thus provided, which restores the pilot valve to its mid position as the piston of the servo-motor moves over.

As will be seen from the foregoing, a very small pressure in the chamber *C* may be used to lift quite a large and heavy float, which will provide more than sufficient power for moving the pilot valve of the servo-motor. The piston rod of the latter is coupled up by appropriate linkwork to the valve gear of the low-pressure cylinder, and thus varies the cutoff so as to maintain a practically constant pressure in the extraction mains.

The lever *E* of the surplus valve is of stainless steel. It is thinned down at its fulcrum end, where it is firmly secured, and bends here when it moves. Friction is thus eliminated, while, at the same time, the lever is efficiently guided so that it cannot swing laterally, but moves only in a vertical plane. The lower end of the surplus valve spindle is rounded, and rests freely in a cup at the end of the lever *E*, so that friction here is also almost completely eliminated. Care has also been taken to reduce to a minimum the friction of the linkwork connected with the floating lever and its accessories.

A safety valve *G* is fitted at the top of the chamber *C*, and a strainer is provided on the steam-admission pipe at *T*. It will be noted that with this regulator the pressure in the extraction mains can be modified at will, merely by tightening or slackening the spring *D* by the handwheel *R*, Fig. 2. The regulator can, of course, be used to control the pressure in any system of steam or air mains, its applications being by no means limited to the control of an engine as described herein.

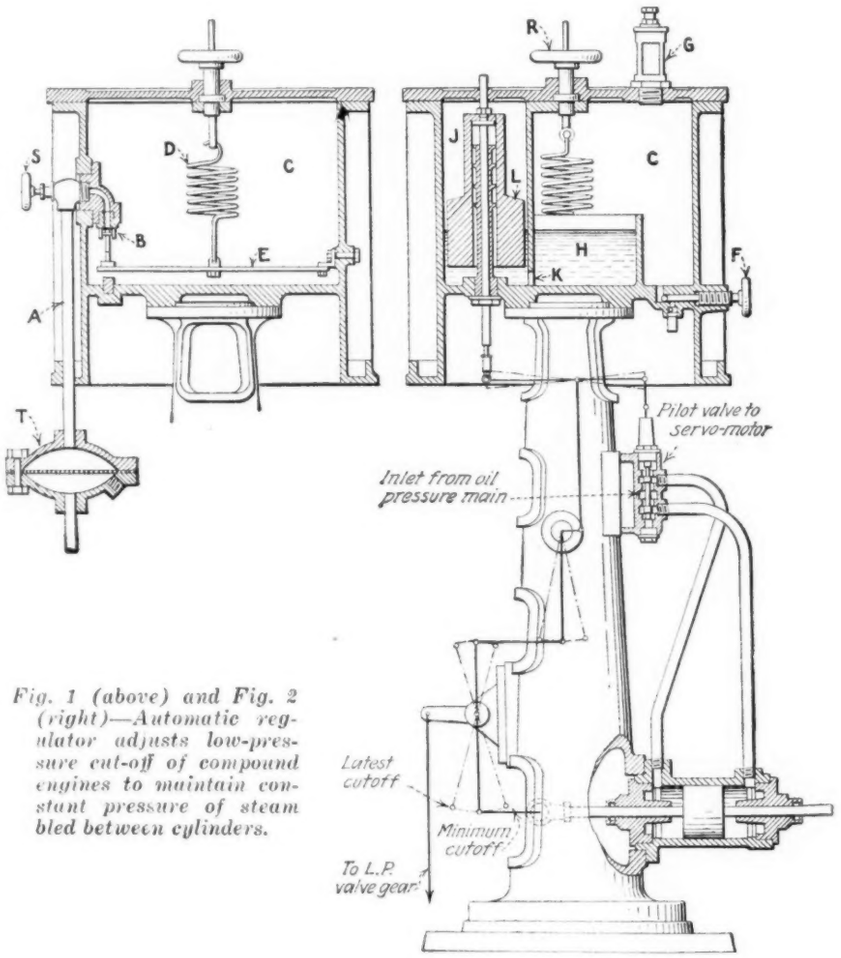


Fig. 1 (above) and Fig. 2 (right)—Automatic regulator adjusts low-pressure cut-off of compound engines to maintain constant pressure of steam bled between cylinders.

Boiler Furnace Refractories at the American Ceramic Society Meeting

AT THE annual meeting of the American Ceramic Society held in Detroit during the week of Feb. 14, the meetings of the Refractory Division opened with a Symposium on Boiler Furnace Refractories.

History of A.S.M.E. Research Work

C. F. Hirshfeld gave an outline of the research on this subject being directed by a special research committee of the American Society of Mechanical Engineers. Three years ago several electricity supply companies having trouble with high boiler furnace walls, entered into a co-operative agreement with the United States Bureau of Mines to investigate the problem. The development of new types of construction pointed out the need of better refractories. A field survey was undertaken to determine the service conditions. Different kinds of coal-burning equipment, coal, and boiler loadings were investigated. The field survey is paralleled with laboratory work to check the field observations and ultimately to select the types of refractories best suited for the various types of service in boiler furnaces. As the list of subscribers extended, the investigation was put under the auspices of the American Society of Mechanical Engineers, and co-operation was obtained with the United States Bureau of Mines, the United States Bureau of Standards and the National Geophysics Laboratory.

Data from Field Survey

The field survey of this investigation was reported upon by R. A. Sherman, who showed interesting data from seven surveys, in which different grades of coal were burned on stokers and in pulverized form. These data included refractory temperatures, gas temperatures, gas compositions, gas velocities, slag compositions and gas quantities. Maximum refractory temperatures ranged from 2,500 to 2,800 deg. F. Gas temperatures as high as 2,900 to 3,000 deg. F. were reported. The quantity of ash in the furnace gas in some cases was thirty times as much in furnaces burning pulverized coal as in furnaces with chain grates. The air-cooling of fireclay brick walls was reported as not very effective in reducing the temperature of the hot surface of the wall. The introduction of air into furnaces near zones of reducing atmosphere adjoining walls greatly reduced the slag erosion.

Laboratory Studies

Samuel J. McDowell reported upon the laboratory phase of this investigation, discussing the four factors that affect the slag erosion of furnace walls, namely, the temperature of the surface of the wall, the composition of the furnace gases, the physical and chemical properties of the refractory, and the composition of the ash. Strangely, the composition of the ash impinging upon the walls and the heating surface is not the same as that in the coal, some of the alkalies having been volatilized in the flames. The microscopic examination of slag-coated refractories from the field survey disclosed many interesting phases of the crystal structure of the slag and refractories that will materially help in determining the fundamental mechanism of firebrick failures.

Silicon Carbide Brick

"The Use of Silicon Carbide[1] Refractories in Boiler Furnaces" was presented by J. A. King. It was stated that slag could be removed from furnace walls by slice bars, steam jets, and by the use of water-cooled or air-cooled surfaces built into the walls of the clinker belt just above the stoker. A belt of solid silicon carbide blocks built into the clinker belt, 24 to 30 in. high, will greatly reduce the clinker trouble. Most of the silicon carbide blocks used for this purpose are air-cooled, air being forced past the backs of them into the plenum chamber under the stoker, or through holes in the blocks into the combustion chamber. Sufficient cooling of the blocks is required to chill the slag on the surface of the block to such an extent that it will congeal and not run down the hot face of the block. The life of such an installation is reported to be four to five years. Torch action with coal containing ash having low fusion temperatures is to be avoided, as the molten slag coming in contact with the silicon carbide block will wash away the block. Oxidation of the material can be minimized by preventing reversals of oxidizing and reducing furnace atmospheres. The high thermal conductivity of silicon carbide makes it particularly well suited for thin walls to preheat combustion air and to shield the relatively cool tubes in water-cooled furnace walls in the combustion zone.

Reducing Shrinkage in Service

G. A. Bole reported encouraging laboratory and short time service tests upon the prevention of shrinkage of diaspor clay[2] bricks in service, by the addition of cyanite[3] to the diaspor clay during the manufacture of the brick. Diaspor clay brick have desirable properties, such as high fusion temperature and consequent high resistance to slag erosion, as well as ability to carry high loads while hot, and to resist spalling. Heretofore, they have given trouble due to shrinkage in service. S. M. Phelps reported upon experiments being conducted upon the more thorough shrinkage of diaspor clay during the calcining process previous to the grinding of the clay. The addition of small amounts of certain chemicals to the clay in this operation greatly reduces the shrinkage of the finished brick in service.

Power in the Brick Plant

Speaking on the "Use and Abuse of Power in Heavy Clay Products Plants," C. A. Millar called attention to the growth of the use of electric power in his industry, with the resulting cleaner plant. To effect economies with purchased electric power, he said, it is sometimes desirable to operate some equipment at night, so as to improve the load factor by reducing the daytime peak load. When steam is needed for drying, of course boilers must be operated. They should be fed with clean water and kept free from scale through adequate cleaning checked up by frequent and thorough inspection. Hand firing, Mr. Millar thinks, is cheaper than stokers for boilers of moderate size, say up to 5,000 sq.ft. of heating surface. He remarked on the advantages of setting the boilers high enough to afford sufficient combustion volume.

[1] Silicon carbide is the chemical name for carborundum.

[2] Diaspor clay is an aluminum hydrate clay.

[3] Cyanite (pronounced kyanite) is the chemical name for a compound of aluminum, silicon and oxygen having the formula Al_2SiO_5.

Combination Marine Steam Power Plants

Attention is being paid in Germany to a method of increasing the economy of marine steam engines which depends on the addition of low-pressure turbines to reciprocating engines. This combination is not in itself new. The novelty of the new system lies in the fact that the exhaust steam of the reciprocating engine is used in a small high-speed turbine which by a double-reduction gear works upon the same line of shafting as is driven by the engine.

The first plant of this type was installed in the German trawler *Sirius*, and has been under close observation for some months. In this vessel the boiler pressure is about 220 lb. per sq.in., and superheating is employed. The reciprocating engine develops 650-700 hp. at 110 r.p.m.

Trials on the test bed showed that the addition of the low-pressure turbine gave an increase of power up to 34 per cent. In trials of the plant after it had been built into the trawler the maneuvering qualities proved excellent, and there was found to be a saving of fuel of from 25 to 30 per cent in comparison with reciprocating marine engines of similar power. Results obtained during the first voyage indicated that if only the reciprocating engine had been working the fuel consumption would have been 29 per cent greater.—*Mechanical Engineering.*

Recent Publications

Die Warmeüberträgung (Heat Transfer). By Dipl.-Ing. M. ten Bosch, Professor at the Technical High School in Zurich. Second Edition. Berlin, Julius Springer, 1927. Cloth; 6x9 in.; 304 pages. Price, RM 22.50.

A treatise on the the general subject, including a mathematical analysis of transfer by radiation and conduction, and the design of heat transfer equipment. There are many diagrams presenting theoretical curves and confirmatory test data. The book should prove valuable to students and engineers who read German.

A First Course in Statistical Method. By G. Irving Gavett, Assistant Professor of Mathematics, University of Washington. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, 1925. Cloth, 6x9 in.; 358 pages; illustrated. Price, $3.50.

This book is a straightforward exposition of the art of statistics written in terms understandable to any intelligent person. The more advanced mathematical topics are covered in appendices. The volume should be helpful to anybody who wants to make a start in the field of statistics. The author has prepared a clear and pleasant path for the beginner.

Brennstoff und Verbrennung 1926 (Fuels and their Combustion). By Dr. D. Aufhaeuser. Published in German by Julius Springer, Berlin, Germany. Paper; 5½ x 8¾ in.; 116 pages, 16 illustrations; 34 tabulations.

This book may be classified as a comprehensive analysis of the thermochemical properties of fuels and the chemistry of their combustion. The author endeavors to show that the combustion process is identical for all fuels and that the variations in the phenomena observed within the boiler furnace are due to the chemical dissociation of the hydro-carbons before combustion begins. The subject matter is presented in a novel and interesting manner with the aid of diagrams and graphs. The book should be well received by combustion engineers and students.

Der neuzeitliche Aufzug mit Treibscheibenantrieb. By F. Hymans and A. V. Hellborn. Published by Julius Springer, Berlin, Germany, 1927. Cloth; 6x9 in., 99 illustrations, 156 pages. Price, $4.

Literature on the basic theory of electric elevator design is very limited, and it is only recently that research engineers began to give this subject the attention that it warrants. In this book the latest theory of traction elevator characteristics is set forth. The book opens with a brief story of the electric elevator and then takes up the different methods of roping up traction elevator machines and the types of grooves used on the sheaves. A chapter has been devoted to the theory of transmission of power by friction between the cables and the grooves in traction sheaves and the effects of different types of grooves. The stopping of the car and the use of oil buffers have been treated in a third chapter, and the fourth chapter deals with standard practice in elevator equipment. The book is written in German and is highly theoretical. For this class of readers it contains much to warrant attention.

The Elastic Deformation of Pipe Bends. By William Hovgaard, Professor at the Massachusetts Institute of Technology. Published by the Institute as publication Serial No. 434, November, 1926. Size, 6x9 in.; 50 pages. Illustrated.

This paper, reprinted from the *Journal of Mathematics and Physics* for November, 1926, presents a new solution of a problem that has caused much trouble and discussion among engineers, namely, the bending of curved tubes.

It has long been known that pipe bends, when exposed to forces tending to alter their curvature, show much larger deflections than can be accounted for by the ordinary formula for bending of curved solid bars, where no sensible deformation of the transverse section takes place within the elastic limit. This discrepancy has been generally ascribed to corrugations or buckles, or to stretching of the material of the pipe wall produced in the process of manufacture, but as shown in this paper, the principal cause of the discrepancy is a deformation of the circular pipe section, which takes a flattened oval form under these conditions. It can be seen at once that when a curved pipe is subject to a bending couple, tending, for instance, to increase the curvature, the tensile stresses on the convex side and the compressive stresses on the concave side must have a tendency to push the wall on both sides of a transverse section in toward the neutral surface. The moment of inertia of the section is reduced, but this in itself cannot account for any material increase in curvature of the bend. The chief cause of this is that the material farthest from the neutral axis is by this deformation enabled to shirk its duty, and is largely relieved of stress, so that the angular deflection of the bend will be much increased before equilibrium with a given bending moment is established.

The paper includes a study of the work of several previous investigators and proposes a new formulation of the relation between deflection and stress, with confirming evidence from tests of full-sized pipe bends conducted in the laboratories of the Institute. Measurements were made of deformation of the transverse section of the bend, and these confirm the theory that the flexibility of pipe bends is due essentially to the deformation of the circular section of the pipe. They showed also that the maximum longitudinal stress does not occur at the extreme points of the circular section, but at a considerably smaller distance from the neutral axis, and that the absolute maximum stress is transverse rather than longitudinal.

This subject is of considerable practical interest to engineers, and Professor Hovgaard's work should prove of considerable value to designers whose technical attainments give them a grasp of the mathematical and graphical presentation of the information that he has adopted. It is the author's intention to continue these studies and to correlate the results already attained with actual engineering practice.

Switching Equipment for Power Control. By Stephen Q. Hayes. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, 1927. Cloth; 6x9 in.; 279 illustrations; 556 pages. Price, $5.

One has only to consider the tremendous size to which electrical supply equipment and systems have grown to appreciate the many problems involved in controlling such systems, with their large networks of transmission and distribution lines stretching for hundreds of miles in all directions. The first edition of this book was published six years ago, but since that time there has been such rapid development in transmission systems, automatic and supervisory control, in truck-type switching equipment, the introduction of European practices into this country and other developments that the author has felt justified in bringing out a second edition in order to present an up-to-date picture of practice in switching and control equipment for power systems.

This new edition has about 100 pages more material than the earlier work, and 38 chapters in place of 16. To switches and different types of circuit breakers eight chapters have been devoted; relays and instruments are treated of in four chapters; lightning arresters and current-limiting reactors are each the subject of a chapter; regulators have two chapters devoted to them; switchboards are covered in four chapters; busbars and breaker structures are each the subject matter of a chapter; American and European practices in inclosed switch gears are discussed at considerable length in two chapters, and three chapters have been devoted to automatic- and supervisory-control equipment.

In the treatment effort has been made to include equipment by all the manufacturers, so that the book may be representative of general practice. A practical presentation of the subjects has been given, and the use of mathematics has been avoided entirely. The object has been to give in a concise form a description of the equipment available and tell how it is used in the best practice. The author presents his subjects in an easily read form and the book contains much of interest for those interested in the electrical switching and control equipment for power generation and distribution.

News in the Field of Power

Welded Brine Cooler Explodes, Injuring Two at Fleischmann Yeast Plant

Safety Valve Shut Off and Warm Water Raises Ammonia Pressure to Bursting Point—Fracture Not in Welded Seam

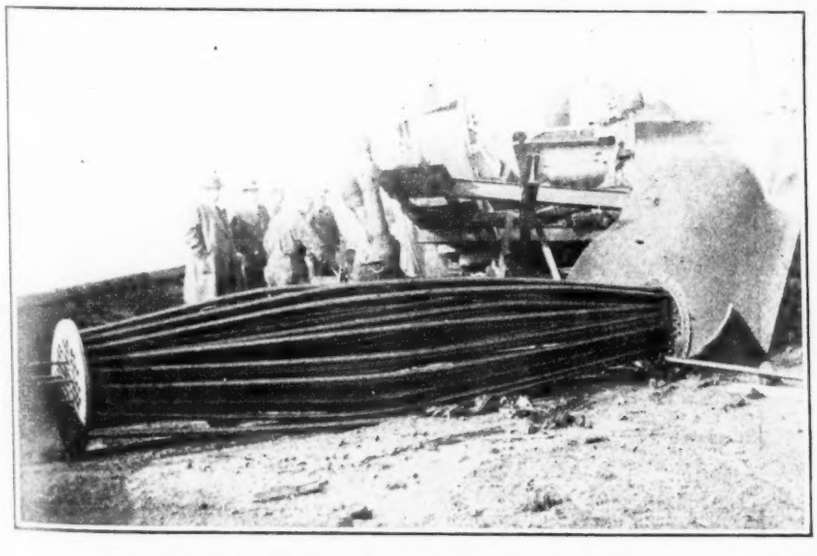
LOCATED on the roof of the Fleischmann Yeast Co. plant on West Nineteenth Street, Chicago, a brine tank blew up during the morning of Feb. 16, injuring two workmen and causing more than 200 employees to abandon their posts.

The workmen were engaged in cleaning the cooler at the time of the accident. This was of the shell-and-tube type, the shell being 26½ in. in diameter, 16 ft. in length and made of ⅜-in. plate. The longitudinal seam and the roundabouts by which the flanges of the shell were set into the tube sheets were fusion (gas) welded. Outside the tube sheets were heavy cast-steel brine boxes, the compartments of which were connected by 2-in. tubes. The brine made ten passes through the tubes, its heat being absorbed by the ammonia in the shell.

The cast-steel brine heads had been removed, but the tube sheets closed the tank tightly at both ends, the liquid inlet valve was closed and the ½-in. safety valve that had been provided to relieve excessive pressure when this unit was shut down was shut off from the shell by a stop-valve, the handwheel of which had been removed. This safety valve was tested after the explosion and blew at 140 lb. That on the adjoining cooler, the exploded one being one of a nest of three, opened at 180 lb.

In the process of cleaning, water at a temperature of 125 or more degrees was played upon the shell. The pressure of ammonia vapor corresponding to a temperature of 125 deg. is about 312 lb.

The longitudinal seam ripped for its whole length for the most part in the sheet alongside the weld. The sheet tore away clean from the roundabout at one end and turned backward, as shown in the photograph reproduced herewith, at the other. About ten tubes were torn off and thrown about 50 ft. The remaining tubes were bowed, as the photograph shows. The normal working pressure was about 25 lb., and the cooler had successfully withstood a shop test of 200 lb.



Showing cooler tube bank with shell torn away by explosion

Alabama Appeals to Coolidge on State Power Claims

Governor Bibb Graves, Senator Underwood and members of the Alabama delegation in the House called upon President Coolidge Feb. 24, acting under a resolution of the Alabama Legislature, and presented claims of the state for control of the Tennessee River within the borders of that state.

The portion of the Muscle Shoals project known as Wilson Dam is in Alabama, and the present move, it was announced, was preliminary to action the state proposed to take to force settlement of the Muscle Shoals power plant controversy.

The memorial read, in part, as follows:

"Subject only to the authority of the United States relative to navigation and to war purposes, the State of Alabama claims title to and ownership, jurisdiction and control of that portion of the Tennessee River which is within the state, including the power in the water.

"Believing that the adjustment of this matter is peculiarly within the powers and functions of the Chief Executive of the nation, we respectfully submit these claims to the consideration of the President of the United States."

Shows General Electric Gave Up Extensive Control

The General Electric Co. has divested itself of the great bulk of its financial interests in electric power companies, the Federal Trade Commission disclosed in a report to the Senate, Feb, 23.

The report was the result of an investigation of the electric power industry, authorized in 1925 under a resolution sponsored by Senator Norris, Republican, Nebraska. At that time it was charged in the Senate that the General Electric Co. "had acquired and was exercising a very extensive control over the electric power industry either directly or indirectly through stockholders or interlocking directors or otherwise."

Having decided to divest itself of its principal instrumentality for controlling operating electric power companies, the Electric Bond & Share Co. in December, 1924, the report declared, the General Electric Co. in its stockholders' lists in October, 1926, showed no dominating stockholders in either company, and there were no common directors.

On interlocking directorships, the report showed that seven General Electric directors held directorships in other companies, but there were "no apparent indications of the exercise of much influence in the latters' affairs." In the directorate of more than 200 companies, termed by the report "in the entire General Electric group," 49 directors held directorships in companies not belonging to that group and there was no indication of undue influence.

Detroit Edison Interchanges With Consumers' Power Co.

Charles W. Tippy, vice-president and general manager of the Consumers' Power Co., has announced an agreement between his organization and the Detroit Edison Co. whereby either system will supply the other with power when the emergency arises. As a result, manufacturing industries not only in Michigan, but also in adjoining States, may soon be operated by the harnessed energy of Ausable River.

This year the Consumers' Power Co. and the Detroit Edison Co. will be able to interchange energy at will.

Full Program for A.I.E.E. Men Meeting at Kansas City

A program of unusual attractiveness to members of the Southwestern district of the American Institute of Electrical Engineers will be presented at the regional meeting to be held in Kansas City, Mo., March 17 and 18, under the direction of District No. 7 of the Institute. The Kansas City Athletic Club at Eleventh and Baltimore Ave. will be headquarters for the meeting, where the technical sessions will be held.

On Thursday, March 17, three papers will be presented; modulator circuits, railway signaling, and automatic substations being the topics. The following day papers on mercury-arc rectifiers, petroleum industry applications, flour mill applications and welding pipes will be presented. A dinner will be served at the Northeast Station of the Kansas City Power & Light Co., the evening of March 18.

M.E.B.A. Delegates Attend Washington Convention

Forty delegates attended the fifty-second annual convention of the National Marine Engineers Beneficial Association which met at the Franklin Square Hotel, Washington, D. C., Feb. 14. President William F. Yates opened the sessions with a short address.

Secretary of Labor Davis, Hon. D. N. Hoover, supervising inspector general, and Representative T. V. O'Connor, chairman of the United States Shipping Board, among others, delivered speeches.

On Tuesday, Feb. 15, an invitation received from the Convention and Tourist Bureau of San Francisco to hold the 1928 convention in that city was referred to the delegates. After consideration this invitation was declined. In the evening a reception was tendered the ladies and delegates. This followed the taking of a group picture of members and friends assembled in the afternoon on the White House lawn, which, as may be seen from the photograph below, included President Coolidge and Secretary Davis.

The banquet of the year's gathering was held Feb. 17. Following toasts by President Yates, speeches were made by Robe Carl White, Assistant Secretary of Labor, Admiral W. S. Benson, Commissioner of the United States Shipping Board, General A. C. Dalton, president of the Fleet Corp., Hon. D. N. Hoover, and Hon. Edward Keating, editor of *Labor*.

S. F. Jeter Is Promoted by Hartford Steam Boiler Co.

At the annual meeting of the board of directors of the Hartford Steam Boiler Inspection and Insurance Co., which met Feb. 8 with the double purpose of lessening the duties of Charles S. Blake, president of the company, and of promoting to executive rank several departmental heads, Sherwood F. Jeter, chief engineer, and Dale F. Reese were elected vice-presidents.

Sherwood F. Jeter

Mr. Jeter came to the company as an inspector in 1898, advanced through the inspection department and in 1915 was promoted to be assistant chief engineer. As vice-president he will have full charge of the engineering and inspection departments.

He was graduated from the Georgia School of Technology in 1893. He is a member of the American Society of Mechanical Engineers, of which he has been a manager and vice-president. He has served on that society's Boiler Code Committee since 1913 and has had an important influence in establishing its standards of safe boiler construction.

A past-president of the Hartford Engineers Club, Mr. Jeter is a member of a number of other technical societies.

Chicago Engineers To Confer on Machine-Shop Practice

For the last few years the Chicago section of the American Society of Mechanical Engineers has considered its spring machine-shop practice meeting one of the major events of the seasonal program. This year a program of exceptional interest has been prepared, including four papers and two industrial motion pictures, that will be presented during the afternoon and the evening of March 16. The Machinery Club, 549 West Washington St., Chicago, has been selected as the meeting place.

In addition to the regular A.S.M.E. membership, invitations have been sent to the members of the Machinery Club, the mechanical division of the Rotary Club, the Western Society of Engineers, and the National Pressed Metal Society, so that with five societies participating, a record-breaking attendance is expected.

Kansas City A.S.M.E. Program Lists Important Topics

Promise of much interest to mechanical engineers who plan to attend the Kansas City meeting of the A.S.M.E., to be held April 4-6 inclusive, is seen in the program of topical papers and subjects which will feature the meeting.

Among the papers scheduled are: "The Place of Railroad Apprenticeship in National Apprenticeship Plant," by F. W. Thomas; "Training for Foremanship," by L. A. Hartley; "Education Training for Industry," by Dean P. F. Walker; "Electrical Power Application in Oil Fields," by D. L. Johnson; "Mechanical Pumping Methods and Equipment," by G. McConnell; "Industrial Management," by James McQueeney; "Railway Shop Administration," by William R. Harris; "Personnel Administration in Steel Industry," by F. V. Larkin; "Treatment of Feed-Water for Industrial and Power-Plant Boilers," by S. T. Powell; "Present Tendencies in Steam-Station Design and Generation," by V. E. Alden; "Kansas City Industrial Development," by Lou Holland; "Carbonization of Coal," by Mr. Runge; "Burning of Mid-West Fuels," by F. S. Collings; "Industrial Furnaces," by V. J. Azbe; "Production and Distribution of Fuel," by C. M. Young; "Protection of Flour Mills and Grain Elevators," F. D. Hoxie.

Delegates to the Marine Engineers Beneficial Association Convention on the White House grounds, among them, affable President Coolidge and Secretary Davis

Boiler Industry Starts Year Well

The year 1927 opened with the boiler manufacturing plants of the country, taken as a whole, reporting productive operations some 9.8 per cent above the operations reported for the opening month of 1926. A considerable part of this increase is probably due to the greater number of large steel heating boilers going into new office buildings, loft buildings and apartment houses, in which line construction is active. Some of the firms reporting build this type as well as power boilers, hence their inclusion. January productive operations, however, were 6.4 per cent under those of December last year, after corrections are made for difference in number of working days. December reported the highest boiler production for any month during the last two years, with the exception of October, 1925. Such is the picture of productive operations in the industry as indicated by the consumption of electrical energy by a large portion of the boiler manufacturing plants of the country.

Undoubtedly, owing to improved operating methods, better organization and more efficient machinery, the boiler manufacturing plants are gradually increasing their actual production per unit of energy consumption. On the other hand, it is possible that increased electrification within these plants may have some effect on the apparent production as indicated by the kilowatt-hour consumption. To what extent this may be a factor, *Power* is endeavoring to ascertain. It is doubtful, under our present-day advances in industrial processes and equipment efficiency, if electrical energy consumption in manufacturing plants can be considered as an accurate indicator of comparative monthly and yearly production operations for a period covering more than two years. As a monthly and yearly comparison, however, there appears to be little doubt that energy consumption can be used as an indicator of productive operations with a large degree of confidence.

The consensus of opinion among stulents of industry at the present time is that business and industrial operations during 1927 will be slightly below those of 1926, probably from 5 to 12 per cent under 1926. It appears likely, however, owing to the extensive utility construction program announced for this year and the fact that credit continues easy to obtain, that the production operations of the boiler manufacturing plants, taken as a whole, during 1927 will slightly exceed those of 1926. Present economic conditions present little to refute this statement.

Large Coal Reserves Lessen Possible Strike Menace

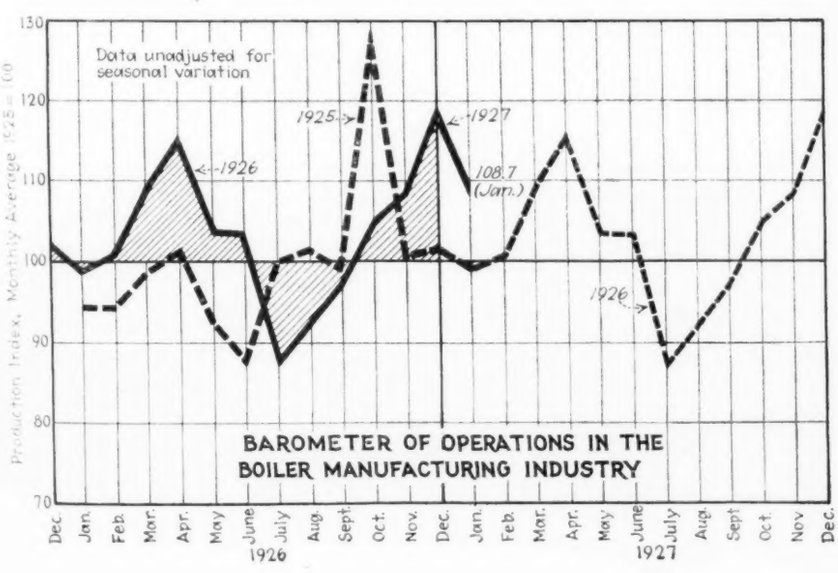
On the eve of the gathering of the representatives of the United Mine Workers and the Mine Owners' Association to take up the possible agreement on a new coal scale in the bituminous regions, the Department of Commerce recently made public statistics which indicate that a reserve is being built up which will make successful conclusion of any strike, when the old Jacksonville agreement expires, almost impossible.

The Bureau of Mines survey of stock as of Jan. 1 last showed in the hands of dealers 55,000,000 tons with 5,567,000 tons in the hands of dealers at the head of the Great Lakes. There also is more than a normal supply of coal in transit, and the investigation indicated that, as compared with a year ago, there is today at least 6,000,000 tons of soft coal in the reserve.

Miners Seek Pay Adjustment Without General Strike

Indications that there will not be a general tie-up of the unionized bituminous coal industry in the event that no working contract for the central competitive field is reached by April 1 was given Feb. 23 by the miners' leaders.

After an executive meeting of the policy committee of the United Mine Workers of America at Miami, Fla. it was learned that districts outside the central competitive field would be allowed to continue operations under the terms of the Jacksonville agreement.



Change of Water Power Act Is Sought in Congress

Bills before the Commerce Committee of the Senate and the Interstate and Foreign Commerce Committee of the House propose a modification of the existing definition of "navigable waters" as it is used in the Federal Power Act. Although they have not as yet been placed before the committee for hearing, they have been the subject of vigorous opposition from Dwight F. Davis, Secretary of War, acting as chairman of the Federal Power Commission.

The Secretary's letter to Mr. Parker, chairman of the House Committee, points out that the change in definition of "navigable waters" as proposed in H. R. 14526 would in effect take from the Federal Power Commission the authority which it now has to pass upon these projects for the purpose of determining whether their construction or operation would effect the navigable capacity of the stream. This would so narrow the jurisdiction of the commission that an immense amount of work would fall to the jurisdiction of Congress.

It is felt by the Secretary that the present system has worked well and has given the desired results to those interested in power projects, at the same time retaining regulation and control of such projects to the extent neceeary for protection of federal interests.

Erratum—The automatic substation equipment described on page 308 of *Power* for Feb. 22, 1927, was purchased from the American Brown Boveri Electric Corp., of New York.

Obituary

Sir James Kemmal, pioneer in the development of electrical power in England, died in London, Feb. 9, at the age of 62. He was managing director of Babcock & Wilcox, Ltd., with whom he had been associated for 40 years.

Jesse F. Duryea, New York millionaire and president of Pierce, Butler & Pierce, New York boiler manufacturing company, died suddenly of a heart attack at the Santa Fe Station, Albuquerque, N. M., Jan. 30. Mr. Duryea was en route to California, accompanied by Mrs. Duryea.

Personal Mention

Robert E. Roesch, electrical engineer, recently returned from Cuba, and is now engaged in the construction of the East River power station of the New York Edison Co.

I. Fallek has severed his connections with Ottenheimer Bros., Inc., of Baltimore, and is now engaged in business as a consulting engineer and also has the agency for the Sterling ammonia compressor for refrigeration. He is operating under the name of the Fallek Engineering Corp., Schenectady, N. Y.

Fred. C. Holtz, chief engineer of the Sangamo Electric Co. and inventor of the Sangamo electric clock, which took the Grand Prix at the Sesqui-Centennial, has been elected vice-president in charge of engineering.

Robert C. Lanphier, electrical engineer and fellow of the American Institute of Electrical Engineers, has been elected president of the Sangamo Electric Co., Springfield, Ill., to succeed the late Jacob Bunn, who had been president of the company since its foundation in 1899.

M. B. Watson, of the Central Technical School of Toronto, Ontario, and chairman of the Ontario Local Section of the A.S.M.E., has been elected a member of the Council of the Association of Professional Engineers of the Province of Ontario, representing the mechanical branch of the profession.

C. T. Baker, consulting engineer, of Atlanta, Ga., has been appointed instructor of refrigeration in the Evening School of Applied Science, Georgia School of Technology. An up-to-date experimental plant, which is being installed under the direction of Prof. Roger S. Howell, will shortly be at his disposal.

P. P. Talati, for 24 years chief engineer of the Ahmedabod Advance Mills at Ahmedabod, India, has resigned this position and will conduct an engineering office in that city, specializing in steam and oil engine power-plant design and supervision. He is desirous of obtaining an agency for an American oil engine company.

Dr. Charles E. Lucke has resigned his position as consulting engineer of the Worthington Pump & Machinery Corp., with which concern he has been connected since his release from duties as Commander in the U. S. Navy during the War. Dr. Lucke is also head of the department of mechanical engineering at Columbia University, New York, N. Y.

Lewis Buckley Stillwell was recently re-elected chairman of the Engineering Foundation for the third time at its annual meeting. Mr. Stillwell, a New York engineer residing in Lakewood, N. J., is past-president of the American Institute of Electrical Engineers and the American Institute of Consulting Engineers. He is a native of Pennsylvania, a graduate of Lehigh, and a life trustee of Princeton.

Society Affairs

The Birmingham Section of the A.S.M.E. will meet to discuss ice at the Alabama Power Co. Building the evening of March 15. W. W. Taylor, consulting engineer with the Rushton Corp., Birmingham, Ala., will be the speaker.

The Philadelphia Section of the Association of Iron and Steel Electrical Engineers will discuss on March 5 "Parallel Operation of Direct Current Apparatus" and "Parallel Operation of Mercury Arc Rectifiers," the last topic being the subject of a paper by O. K. Marti of the American Brown Boveri Electric Corp.

Coming Conventions

American Institute of Electrical Engineers. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Kansas City, Mo. regional meeting March 17-18, Bethlehem, Pa. regional meeting April 21-23, Pittsfield, Mass. regional meeting May 25-27. Summer convention at Detroit, Mich., June 20-24 inclusive; Pacific Coast convention at Del Monte, Calif., Sept. 13-16.

American Oil Burner Association. Annual convention and exposition at Buffalo, N. Y., April 5-7, inclusive; C. F. Olmstead, 350 Madison Ave., New York City.

American Refractories Institute. Annual meeting probably in April; D. A. Texter, secretary, 2202 Oliver Bldg., Pittsburgh, Pa.

American Society of Civil Engineers. George T. Seabury, secretary; Spring convention at Asheville, N. C., April 20-22. Annual convention at Denver, Col. July 13-15.

American Society of Mechanical Engineers. Spring meeting at White Sulphur Springs, W. Va., May 23-26. Calvin W. Rice, secretary. Midwest regional meeting will be held in Kansas City, April 4-6 inclusive; F. S. Dewey, chairman of the Kansas City Section.

American Society of Refrigerating Engineers. Western meeting at White Sulphur Springs, W. Va., May 23-25, in conjunction with the Spring meeting of the A.S.M.E.; W. H. Ross, secretary, 35 Warren St., New York City.

American Water Works Association. W. M. Niesley, assistant secretary, 170 Broadway, N. Y. Annual convention Hotel Sherman, Chicago, June 6-11.

American Welding Society. Annual meeting at 29 West 39th St., New York City, April 27-28-29.

Association of Iron and Steel Electrical Engineers. Annual convention in conjunction with Iron and steel exposition at Pittsburgh, Pa., June 13-18, inclusive.

Heating and Ventilating Exposition. Will be held at Twelfth Regiment Armory, New York City, March 14-19 inclusive.

National Association of Practical Refrigerating Engineers. Annual convention probably in November; E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Association of Stationary Engineers—Annual convention, in conjunction with the Pacific Coast Power Show, will be held at the Ambassador Hotel, Los Angeles, Calif., Aug. 22-27 inclusive, John Topman, secretary, convention committee, Ohio State annual convention in Memorial Hall, Lima, Ohio, June 16-18, inclusive, in conjunction with the Northwestern Ohio Power Show; P. H. Grigsby, secretary of convention committee, Lima, Ohio. New England States convention at Portland, Me., June 17-18. Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass. Indiana State convention at Anderson, May 27-28; George S. Billman, secretary.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting at Nashville, Tenn., during second week of June.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Annual convention at Atlantic City, week beginning June 6.

Universal Craftsmen Council of Engineers. Thomas H. Jones, secretary, 33 Linden Ave., Cherrydale, Va. Annual convention at Buffalo, N. Y. Aug. 2-6.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Feb. 21 1927
Pool 1	New York	$2.75@$3.25
Smokeless	Boston	1.88
Clearfield	Boston	1.60@ 2.00
Somerset	Boston	1.85@ 2.15
Kanawha	Columbus	1 40@ 1.75
Hocking	Columbus	1 75@ 2.00
Pittsburgh	Pittsburgh	1.80@ 1.90
Pittsburgh gas slack	Pittsburgh	1.40@ 1.50
Franklin, Ill.	Chicago	2 50@ 2.75
Central, Ill.	Chicago	2.00@ 2 25
Ind 4th Vein	Chicago	2.40@ 2.50
West Ky.	Louisville	1 35@ 1.65
S. E. Ky.	Louisville	1.50@ 1.85
Big Seam	Birmingham	1.50@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1.	New York	3 00@ 4 00
Buckwheat No. 1.	Philadelphia	2.75@ 3.75
Birdseye	New York	2.00

FUEL OIL

New York—Feb. 24, light oil, tank-car lots; 28@34 deg. Baumé, 6c. per gal.; 36@40 deg., 6¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Feb. 16, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.00@$2.05 per bbl.; 26@28 deg., $2.05@$2.10 per bbl.; 28@30 deg., $2.10@$2.15 per bbl.; 30@32 deg., $2.15@$2.20 per bbl.; 32@36 deg., gas oil, 6.25c. per gal.; 38@40 deg., 7c. per gal.

Pittsburgh—Feb. 15, f.o.b. local refinery; 30@34 deg., fuel oil, 6¼c. per gal.; 36@40 deg., fuel oil, 6.37½c. per gal.

Philadelphia—Feb. 16, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.90@$1.96 per bbl.

Cincinnati—Feb. 14, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Feb. 15, tank-car lots, f.o.b. Oklahoma. freight to Chicago, 92c. per bbl.; 24@26 deg., $1.27½ per bbl.; 26@30 deg., $1.35; 30@32 deg., $1.75.

Boston—Feb. 21, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.85c. per gal.; 28@32 deg., 6c. per gal.

Dallas—Feb. 19, f.o.b. local refinery, 26@30 deg., $1.75 per bbl.

Business Notes

The New York Engineering Co. has recently moved its offices to the Evening Post Building, 75 West St., New York City, which has just been completed. They formerly occupied 2 Rector Street where they have been for the last twenty years.

The Elliott Co., Pittsburgh and Jeannette, Pa., with works also at Ridgway, Pa., and Wellsville, N. Y., announces the election of additional executive officers. James E. Watson continues as executive vice-president. G. F. Elliott

has been elected a vice-president and assistant to the president, W. S. Elliott, and appointed general manager in charge of the Ridgway Dynamo & Engine works of the Elliott Co. R. N. Ehrhart has been elected a vice-president in charge of engineering.

The Whiting Corp. has made the following changes in its sales organization: R H. Bourne, formerly vice-president and sales manager, is now senior vice-president and will devote his time to the Grindle Fuel Equipment Co. and Joseph Harrington Co. sales. N. S. Lawrence, formerly vice-president and assistant sales manager, is now vice-president and sales manager in charge of sales for the Whiting Corp. and Swenson Evaporator Co. lines. Mr. Lawrence will be assisted by A. H. McDougall, vice-president and consulting engineer, and R. E. Prussing, vice-president in charge of district offices and agents.

Trade Catalogs

Diffuser Steam Purifiers — The Schutte & Koerting Co., Philadelphia, Pa., in bulletin No. 9-P devote consideration to their diffuser steam purifiers designed to remove from steam and vapor the moisture, dirt and other impurities which interfere with proper operation of the equipment in which this steam is used. They are built in two styles and in several sizes, and this bulletin describes the various construction and operating features and their application to steam purification in power and industrial plants.

Recording Pressure and Vacuum Gages—The Brown Instrument Co., Philadelphia, Pa., has issued Catalog No. 75 covering a complete line of indicating, recording, signalling and controlling pressure gages manufactured by the company. This catalog is a revision of a former edition, and features all types of round case instruments, and in addition, single-record, duplex-record, multiple-record, and multiple-duplex-record models of strip-chart pressure recorders. In addition to pressure and vacuum gages the catalog includes descriptions and illustrations of Brown draft gages. A thoroughly revised copy will be sent to responsible industrial executives on request.

Surface Condenser Leakage and Boiler Water Concentration—The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., has issued Bulletin No. 496 on measuring the impurities in boiler feed water. This bulletin, power plant series No. 4, contains much valuable information. The first part considers the impurities in boiler feed water, their effects and the condition under which they get into the boiler. Then the various methods of measuring these concentrates are explained. A number of typical installations are shown. This bulletin is more than a catalog, as it tells an interesting story on an important feature in boiler operation.

Brown Electric CO_2 Meters—Application of the thermal-conductivity method of CO_2 measurement further developed by the Brown Instrument Co., Philadelphia, Pa., through important improvements in the design and construction of the Brown electric CO_2 meter, is the topic of catalog No. 33. These improvements radically simplify the construction and installation of the elements of the instrument apparatus through which the gas passes. Filters, condenser and cell block are combined in one unit by the new arrangement. Also a novel construction of combined sampling-tube filter and thermocouple allows the flue-gas temperature and gas sample to be obtained through a single opening in the flue wall or uptake. The catalog also contains a short introduction covering the relation of furnace operating economy to CO_2 in flue gas, followed by an explanation of the Brown Electric CO_2 meter operating principle, design and advantages, with descriptions and illustrations of indicating and recording models.

New Plant Construction

Ark., Springdale—City will soon receive bids for waterworks improvements including pumping plant, mains, etc. Estimated cost $50,000.

Calif., Long Beach—City had plans prepared for the construction of two pumping stations, pipe lines, etc. at pump district 10. R. D. Van Alstine, is city engineer.

Calif., Los Angeles—I. Stone, 1528 West Adams St., is having preliminary plans prepared for the construction of a 10 story apartment including automatic refrigeration system, electric elevators, etc., on West Adams St. Estimated cost $1,000,000. L. H. Meeks, 2614½ Juliet St., is architect.

Calif., Los Angeles—United Artists Theatre Corp., 922 South Olive St., is receiving bids for the construction of a 12 story theatre and office building including steam heating system, 4 elevators, etc. on Broadway. Estimated cost $1,000,000. Walker & Eisen, Western Pacific Bldg., are architects.

Calif., Red Bluff—City, E. F. Lennon, Clk. will soon award contract for waterworks improvements including drilling of well, furnishing and installing 750 g.p.m. pump and motor, etc.

D. C., Washington—H. Wardman, plans the construction of an 11 story hotel including steam heating system, 4 electric elevators, etc. at 18th and G Sts. Estimated cost $3,000,000. Private plans.

Ill., Belleville—Franciscan Order of Sisters of Charity, c/o St. Elizabeth's Hospital, 328 West Lincoln St., is having preliminary plans prepared for the construction of a hospital including steam heating system, etc. Estimated cost $500,000.

Ill., Chicago — Agar Packing Co., 4057 South Union Ave., awarded contract for the construction of a power house at 4019 South Union Ave. Estimated cost $40,000.

Ill., Chicago — H. Paschen of Pachen Bros., 111 West Washington St., will build a 23 story office and store building including steam heating system, elevators, etc., at Michigan Ave. and South Water St. Estimated cost $2,000,000. Z. T. Davis, 400 North Michigan Ave., is architect. Owner is general contractor.

Ill., Galesburg—City is having plans prepared for the construction of a water pumping station. Pearse, Greeley & Hansen, 6 North Michigan Ave., are engineers.

Ill., Springfield—City, J. E. Smith, Mayor, had sketches made for the construction of a 10 story office building. Estimated cost $1,500,000. Helmle & Helmle, First National Bank Bldg., are engineers.

Ind., Indianapolis — School Comrs., 150 North Meridian St., awarded contract for the construction of a school, to H. R. Blagg Co., 1229 East 3rd St., Dayton, O. Estimated cost $1,200,000. Steam heating and ventilation systems, etc. will be installed.

Ky., Louisville — Heyburn Building Co., 403 West Ormsby St., awarded contract for the construction of a 17 story office building at 4th St. and Broadway to Struck Construction Co. Estimated cost $2,000,000.

Md., Hagerstown—Mayor and City Council, will receiv bids until Mar. 8, for waterworks improvements including filtration plant, pumping station, reservoirs, etc., will also soon award contract for the construction of an electric light plant. G. L. Bean, Abbott Bldg., Philadelphia, Pa., is engineer.

Mass., South Boston—(Boston P.O.) Commonwealth Ice & Cold Storage Co., A. L. Barker, V. Pres., 220 Northern Ave., had plans prepared for the construction of an ice and cold storage plant. E. N. Pike, 38 Chauncy St., Boston, is architect.

Mich., Detroit—Bd. of Water Comrs., G. H. Fenkell, 176 East Jefferson Ave., Gen. Mgr., plans the construction of an emergency pumping station and water intake and tunnel from waterworks to intake at head of Detroit River.

Minn., Minneapolis—Intersection Holding Co., M. T. Baker, Pres., Baker Bldg., awarded contract for the construction of a 12 story office building at Seventh St. and Marquette Ave. to J. Leck Co., 211 South 11th St. Estimated cost $900,000. Steam heating and refrigeration systems, elevators, etc. will be installed.

Mo., Cape Girardeau — Hotel Securities Corp., E. E. Singleton, 626 Pine St., St. Louis, will receive bids about Mar. 5 for the construction of a 6 story hotel including steam heating system, elevators, etc. at Broadway and Fountain St. Estimated cost $500,000.

N. J., Jersey City—Merchants Refrigerating Corp., 17 Varick St., New York, plans the construction of a cold storage plant here. Estimated cost $100,000. Private plans.

N. J., Montclair — Harrison-Van Duyne, Inc., Kinney Bldg., Newark, is having plans prepared for the construction of an 11 story apartment including steam heating system, elevators, etc., at Claremont and Bloomfield Aves., here. Estimated cost $1,000,000. Shape, Bready & Peterkin, 285 Madison Ave., New York, N. Y., are architects.

N. J., Totowa (mail Paterson)—State Institutions and Agencies, State Bldg., Trenton, awarded contract for the construction of a power house, for Training School for Feeble Minded Females here to E. M. Waldron, 127 Central Ave., Newark. Estimated cost $48,278.

N. Y., Brooklyn—Jewish Hospital, awarded contract for the construction of a hospital and nurses' home on Prospect Pl. to Thompson-Starrett Co., 250 Park Ave. Estimated cost $2,200,000.

N. Y., Middletown — Dept. of Mental Hygiene, Capitol, Albany, will receive bids until Mar. 23, for the construction of a refrigeration plant for Middletown State Hospital, here.

N. Y., New York—Bellevue & Allied Hospitals, D. McGrath, Pres., ft. of East 26th St., will soon receive bids for the construction of addition to hospital at Croton Ave. and Southern Blvd. Estimated cost $1,500,000. Starrett & Van Vleck, 393 7th Ave., are architects.

N. Y., New York—Chase National Bank, 57 Broadway, will soon receive bids for the construction of a 30 story bank and office building on Nassau St. Estimated cost $10,000,000. Graham, Anderson, Probst & White, 1417 Railway Exchange Bldg., Chicago, Ill., are architects.

N. Y., New York—Rose Marie & Co., Inc., A. Hammerstein, Pres., 1650 Broadway, awarded contract for the construction of a 15 story theatre and office building including 4 electric elevators at 211 West 53rd St. to O'Day Construction Co., 1639 Broadway. Estimated cost $1,500,000.

N. Y., New York—Rubel Coal & Ice Corp., Glenmore Ave. and Jamaica St., plans to remodel ice manufacturing plant on St. Anns Ave. Estimated cost $500,000. E. M. Adelsohn, 1778 Pitkin Ave., is architect.

N. C., Marshall—Carolina Power & Light Co., C. S. Wallace, Gen. Mgr., Raleigh, plans the construction of a power plant and high tension lines from Spruce Pine to Marshall. Estimated cost $300,000.

N. C., Raleigh—City will soon receive bids for the construction of an auxiliary waterworks system including pumping equipment, clearing of reservoir, etc. Estimated cost $325,000. W. C. Olsen, Raleigh Building & Loan Bldg., Raleigh, is engineer.

O., Akron—M. O'Neil Co., South Main St., awarded contract for the construction of a 4 and 6 story department store to Carmichel Construction Co., Central Savings & Trust Bldg. Estimated cost $3,000,000.

O., Cleveland—Green Dry Cleaning Co., R. Adler, c/o Cuyahoga Abstract Title & Trust Co., 723 Superior Ave., awarded contract for the construction of a dry cleaning plant and boiler house to S. Freidman & Machlis, 178 Corydon Rd. Estimated cost $40,000.

O., Dayton—Bd. of Trustees, G. H. Brooks, Pres., is having plans prepared for the construction of a 5 story hospital for National Military Home. Estimated cost $1,500,000.

O., Middletown—P. A. Sorg Paper Co. is having plans prepared for the construction of a power plant. Estimated cost $100,000. W. D. Spengler, Union Trust Bldg., Cleveland, is architect and engineer.

O., Toledo—City Council, plans an election to vote $1,955,000 bonds for the construction of sewage disposal works and pumping stations.

Okla., Centralhoma — City Council, is having preliminary plans prepared for the construction of a new waterworks system including well, deep well pump, mains, etc. Estimated cost $18,000. Engineer not selected.

Okla., Lawton—South Western Light & Power Co., Barniff Bldg., Oklahoma City, had plans prepared for the construction of a 65 ton addition to raw water ice plant, here. Estimated cost $140,000. D. R. Erusberger, Braniff Bldg., Oklahoma City, is engineer.

Okla., Muskogee—Southern Ice & Utilities Co., J. M. Allen, plans the construction of a 50 ton ice plant, probably electrically driven. Estimated cost $75,000. Private plans.

Pa., Philadelphia—Philadelphia Storage Battery Co., C and Ontario Sts., awarded contract for the construction of addition to boiler house to Stewart Bros., 2526 North Orkney St.

S. D., Aberdeen—A. L. Ward, 1216 North Main St., plans the reconstruction of a 7 story hotel including steam heating system at Main St. and First Ave., recently destroyed by fire. Estimated cost $500,000. Architect not selected.

Tex., Amarillo—City, J. D. Bartlett, Mgr., awarded contract for waterworks improvements including storage reservoir, pumping station, pumping equipment, etc., to Spotts & Malcolm, Loveland, Colo. Estimated cost $163,000.

Wis., Milwaukee—Schroeder Hotel Co., 86 Michigan St., awarded contract for the construction of a 15 story hotel on Grand and 5th Sts. to W. W. Oeflin Inc., 86 Michigan St. Estimated cost $3,000,000. Contract for boilers awarded.

B. C., Campbell River—Crown Willamette Paper Co., Pittock Bldg., Portland, Ore., has made agreement with the British Columbia Government for the construction of a hydro-electric development on Campbell River Falls, also plans a paper (newsprint) mill, initial capacity 200 tons daily, ultimate total capacity 1,000 tons. Estimated cost $15,000,000. Ultimate total cost $50,000,000. B. C. Condit, 365 Bellevue St., Oakland, Calif., is engineer.

Ont., Gravenhurst—Muskoka Beach Co., c/o Front, Dillon & Birks, Federal Bldg., plans the construction of a 3 and 4 story hotel including steam heating system. Estimated cost $400,000 to $500,000. E. L. Sheppard, 57 Queen St. W., is architect.

Ont., Saulte Ste. Marie—A Grant and syndicate, 505 Albert St. E., plan the construction of a 4 or 5 story hotel including steam heating system, elevators, etc., at Bay and East Sts. Estimated cost $500,000. Architect and engineer not selected.

Ont., Toronto—Canadian Pacific Railway Co., Montreal, Que., plans the construction of a hotel including steam heating system, elevators, etc. on Front St. here. Estimated cost $5,000,000. Architect not selected. J. M. R. Fairbairn, is chief engineer.

Ont., Toronto—King Edward Hotel, King St. E., plans the construction of a 5 story addition to hotel including steam heating system, elevators, etc. Estimated cost $300,000 to $500,000. Architect not selected.

Ont., Windsor—Essex Border Utilities Comn., Murray Bldg., plans the construction of a 15,000,000 g.p.d. filter unit including pumps, motors, etc. Estimated cost $750,000. J. C. Keith, Murray Bldg., is engineer.

Que., Hull—The Gatineau Power Co. had acquired the plant of the Papineauville Electric Co., on the Ottawa River and plans extensions and improvements to increase the capacity. Estimated cost $250,000.

Equipment Wanted

BOILERS, PUMPS, ETC.—Water Comn., Goderich, Ont., prices and catalogs on boilers, pumps, etc. for proposed auxiliary pumping plant. E. H. Darling, 72 James St., N. Hamilton, is engineer.

CENTRAL CONTROL SYSTEM—Utilities Comn., E. V. Buchanan, Gen. Mgr., London, Ont., plans the installation of a central control system in main station. Estimated cost $40,000.

COLD STORAGE & REFRIGERATION EQUIPMENT — South Western Light & Power Co., Baniff Bldg., Oklahoma City, Okla., plans the installation of cold storage and refrigeration equipment including circulating pumps, condensers, ice handling equipment, brine tank, etc. to increase the capacity 50 ton. Estimated cost $40,000. E. R. Erusberger, Braniff Bldg., Oklahoma City, is engineer.

DIESEL ENGINES AND STEAM BOILERS—W. L. Cunningham, 1334 Burton Ave., Ravinia, Ill., prices and catalogs on Diesel engines (large and small) and steam boilers.

ENGINE, ETC.—Texas Tie & Lumber Co., 1358 Harrison Ave., Orange, Tex., prices and catalogs on 75 hp. engine, lumber conveyors, etc. for proposed mill and lumber plant.

GAS ENGINE AND ELECTRIC MOTOR—L. P. Black, City Clk, Monrovia, Calif., plans to purchase a gas engine and electric motor for San Gabriel pumping plant.

ICE PLANT MACHINERY—Rubel Coal & Ice Corp., Glenmore Ave. and Jamaica St., Brooklyn, N. Y., machinery for ice manufacturing plant to be remodeled.

ICE PLANT MACHINERY — Rockwell Mfg. Co. is in the market for Frick machinery for proposed 25 ton ice plant.

PUMP—Bureau of Yards & Docks, Navy Dept., L. E. Gregory, Ch. of Bureau, Washington, D. C., will receive bids until Mar. 16, for motor driven centrifugal pump, etc., for proposed water purification plant at Naval Radio Station, Darien, C. Z.

PUMP—Mayor and City Council, Sea Girt, N. J., will receive bids until Mar. 15 for furnishing and installing one 1,000 g.p.m. pump direct connected to 50 hp. motor.

PUMP AND GAS ENGINES—E. L. Vegely, City Clk, Santa Ana, Calif., plans to purchase one deep well turbine pump, one 120 hp. and one 160 hp. gas engines.

PUMP AND MOTOR, ETC. — City of Brainard, Neb., voted $20,000 bonds for waterworks improvements including 125 g.p.m. centrifugal pump, 15 kva., single ph. motor, etc. Fulton & Letton, 525 South 13th St., Lincoln, are engineers.

PUMP AND MOTOR—G. S. Miller, Supt., Water Works, Hawthorne, Calif., plans to purchase one 450 g.p.m. booster pump and motor against 130 ft. head.

PUMPS, MOTORS, ETC.—Sewer Comrs., Freeport, N. Y., will receive bids until Mar. 14, for pumps, motors, etc. for proposed sewage treatment plant and pumping station. N. S. Hill, Jr., 112 East 19th St., New York, is consulting engineer.

REFRIGERATING MACHINE — Constructing Quartermaster, San Francisco, Calif., will soon receive bids for a 5 ton refrigerating machine for Fort McDowell.

TRANSFORMERS—Bd. of Purchase, H. C. Cain, Secy., City Hall, Columbus, O., will receive bids until Mar. 10 for distribution transformers, four 25 kva. and two 50 kva., 2,300-230/115 v., 60 cycle, single ph., also four 15 kva., four 25 kva., two 50 kva., two 75 kva., two 100 kva. and two 150 kva., 6,900-230/115 v., 60 cycle, single ph., for electric light plant.

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